THE PHILIPPINE JOURNAL OF SCIENCE

VOL. 41 MARCH, 1930 No. 3

CLINICAL SKIN LESIONS IN PHILIPPINE MONKEYS RESULTING FROM EXPERIMENTAL INOCULATION WITH HUMAN LEPROUS MATERIAL[1]

By OTTO SCHÖBL

Chief, Division of Biology and Serum Laboratory, Bureau of Science, Manila

ELOY V. PINEDA

Chief, Leper Department, San Lazaro Hospital, Philippine Health Service

and

ISAO MIYAO

Lieutenant Surgeon, Imperial Japanese Navy

SIX PLATES

It is not within the scope of this communication to review completely the past attempts to transmit leprosy to experimental animals. Kolle and Hetsch[2] made the statement that none of the investigators were successful in producing specific lesions in animals including monkeys. They state that Damsch, Melcher, Ortmann, Vossius, and Baranikow obtained some positive results in rabbits. But Kolle and Hetsch remark that it was not proven beyond doubt that these lesions were not mere encapsulated deposits of lepra bacilli, tuberculosis, or some natural infection of these animals. Nicolle, Marchoux, and Bour-

[1] Presented for publication, September 14, 1929.

[2] Die Experiment. Bacteriologie u. die Infektionskrankheiten 2: 778. Sixth edition.

ret experimented with chimpanzees with doubtful or negative results according to Kolle and Hetsch. These authors further quote Kyrle's experiment in which three Rhesus monkeys were inoculated in the skin of the eyebrows with human material rich in acid-fast bacilli. After an incubation of eighteen to twenty-two days nodules, the size of a cherry stone, developed. After four weeks these lesions disappeared without showing any tendency to softening or central breaking down. In the early stage, proliferative inflammatory tissue with vacuolated giant and lepra cells containing numerous acid-fast bacilli were found in the lesions.

The consensus of opinion with regard to the results of the past attempts to transmit the disease to the animals seems to be generally skeptical, for Kolle and Hetsch [3] conclude their review of experimental leprosy by saying: "With all the skepticism as to the results of animal experimentation one need not give up the hope that some day a strain of *B. leprae*, virulent for animals or *a really appropriate method of inoculation will be found.*"

The great significance of mass infection and superinfection in chronic infectious diseases is being more and more recognized by clinicians and epidemiologists. Due to the realization of these important factors our concept of tuberculous infection is undergoing a radical change. In view of the high infestation by leprosy in some localities it is conceivable that every one of us must at one time or other come into contact with leprous material in such a way as may cause infection. Yet not all exposed persons contract leprosy. As an explanation of this, reasons are given which either cannot be rationally defined, or cannot or have not been proven; lowered vitality, poor nutrition, hereditary predisposition, etc.

Based on statistical and epidemiologic evidence the general belief is that the incubation period in leprosy is long. But is the actual breaking out of the disease due to one infection, or is it provoked by repeated superinfections? This question cannot be answered either by clinical observations or by epidemiologic studies.

In the clinical course of leprosy there are phenomena and manifestations strongly indicating in certain respects a similarity between leprosy and other chronic infectious diseases which are understood better than leprosy. The preference to skin, the

[3] Loc. cit.

initial lesion followed by early metastatic generalized dissemination, the variety of chronic skin lesions including ulceration and hyperkeratosis remind one of yaws. The neurotropic forms of infection by *B. lepræ*, which interestingly enough show relatively insignificant skin lesions, remind one of syphilis even though peripheric nerves are affected in leprosy rather than the central nervous system as in syphilis. Aside from the allergic phenomenon, the so-called "lepra reaction," nothing is known with regard to immunity in leprosy, a disease that has been written about since biblical times, treated since Buddha's times with the same drug as to-day, and the causative agent of which has been known longer than the cause of any other infectious disease of man. More various strains of *B. lepræ* have been isolated in culture than of any other causative agent of one disease. The recognition of the one or the other culture as a true *B. lepræ* depends mostly on the enthusiasm of the discoverer himself. Very complicated media, containing odd substances from placentar amido acids to Japanese garlic, have been devised for the cultivation of *B. lepræ* on artificial media. But the crucial test, Koch's third postulate, left the bacteriologist in the lurch.

The clinical course of the disease and the various manifestations have been extensively studied, and the treatment has been improved. Lepers have been segregated from times immemorial, and to-day leprosy is the only chronic infectious disease in which compulsory segregation is practiced. In spite of all that, our understanding of this disease is not what it should be by now. It is evident that there is a gap in our knowledge of leprosy which can be filled only by experimental research.

EXPERIMENTAL PROCEDURE

Inoculations of leprous material into monkeys were undertaken about ten years ago in the Bureau of Science by Dr. Liborio Gomez[4] and later by Dr. A. W. Sellards.[5] The results remained unpublished and nothing definite came from the experiments. Schöbl was an eyewitness to some of Gomez's experiments and a collaborator with Sellards in others, and the impression was gained that, after all, the problem may not be as hopeless as textbooks and handbooks would have us believe.

[4] Formerly chief of the division of biology, Bureau of Science, Manila.
[5] Of the Harvard Medical School, Boston, Massachusetts, U. S. A.

Encouraged by the success in producing a great variety of clinical yaws lesions in monkeys by superinfection and reinfection,[5] we applied the same method of animal inoculation in the lepra experiments.

We resorted, therefore, to repeated intradermal injections of a fine suspension of leprous tissue obtained from patients and containing lepra bacilli. The object of the repeated inoculations was to produce an allergic condition which would allow the infection to establish itself in the experimental animal.

The details of the experimentation with leprosy were planned and the first animal was inoculated in the latter part of December, 1928. The animal was inspected at frequent intervals but the skin at the places of the original, as well as the following, inoculations remained without a change, so much so that we did not feel inclined to extend our experiments further since this normal state of the experimental animal lasted longer than two months. By the middle of March, 1929, distinct indurated lesions developed at the places of inoculations. They were hard indurations located in the skin, movable over the base. They contained no pus, and acid-fast bacilli were found in fair numbers in the smears made from the incised lesions. Encouraged by this finding we subjected another Philippine monkey to a course of inoculations similar to those received by the first monkey.

The literature concerning leprosy is so scattered over the multitude of polyglot medical journals that one can never feel confident that in quoting literature concerning experimental leprosy important publications have not been omitted.

For the sake of fairness to workers in experimental leprosy who have in the past devoted their time and energy to this thankless task, and for the information of those who may in the future take up the subject we feel obliged to publish our experimental record notes. In addition to the records, photographs are included with the intention to convey to the reader, as far as possible, the impressions we gained in the course of our experiments.

Two Philippine monkeys were inoculated repeatedly by intracutaneous injections of leprous material obtained from human patient's lesions and emulsified in salt solution.

One of the two animals (Lep. No. 1) developed hard nodular infiltrations at the places of inoculations within two and one-

[5] Philip. Journ. Sci. 35 (1928) 209–332.

half months after the first inoculation and after two separate inoculations were administered. About two weeks after the hard nodules were first observed the lesions all at once softened and showed superficial dry desquamation of the skin covering the lesions. Approximately three weeks after the first appearance of the local lesions the nodules were found considerably larger but distinctly soft, and central necrosis set in leaving ulcers of various sizes at the places of inoculations. The ulcers were covered with tenacious leathery scabs. Upon removal of the scabs the granulating bases of the ulcers were found to secrete thin grayish pus. The ulcers continued spreading. About four months after the first inoculation the lesions began to heal, and five and one-half months after the first inoculation the healing of the ulcers by scar formation was practically completed. Superinoculations with human leprous material were continued after the complete development of the ulcers, and during the healing of the ulcers there were produced small nodular lesions which softened rapidly and disappeared without going through the ulcerative stage before healing.

The other of the two monkeys (Lep. No. 2) received four inoculations within less than a month. The animal developed slight indurations at the points of inoculations within a month after the first inoculation. In the course of the next month three more inoculations were performed. The nodular lesions persisted during this time, increased in size, and some of them showed slight superficial desquamation, but three months and three weeks after their development they commenced to flatten and heal.

Briefly summarized these lesions showed the following clinical characteristics:

1. A fairly long absolute incubation.

2. An allergic stage of tissue reactivity manifesting itself by a rather sudden appearance of hard indurations at all the places of previous inoculations performed at various times during the incubation.

3. This allergic condition had three stages in the development of the lesions.

(*a*) The stage of hard cutaneous infiltration containing no pus but a fair number of acid-fast bacilli single or arranged in bundles.

(*b*) The stage in which the lesions spread out, became flat and soft, and showed central breaking down of the tissues. Thin grayish pus escaped from the central part of the lesion

containing acid-fast bacilli at times phagocytized. Globi predominated over single bacilli and bundles.

(*c*) The stage in which the central necrosis spread towards the periphery of the lesion which became stationary by that time. An ulcer resulted with an elevated, irregular, punched-out border. It was covered by a dry scab under which thin viscous grayish pus was accumulating. The base of the ulcer was formed by slightly bleeding granulation tissue. Very few globi or none at all were found in this stage.

(*d*) The stage of healing when the lesions showed flattening of the margins, drying and cicatrization from the periphery.

DISCUSSION

As far as we can judge from our limited experimental evidence the prospects of success in experimentation on animals with the view of studying leprosy appear to be somewhat brighter than might be concluded from the skeptical opinion found in textbooks and handbooks. The procedure of experimentation, that is the repeated massive superinfection with leprous material is very promising. There is no doubt that this procedure produced in the one monkey an allergic condition favorable to the formation of advanced specific lesions. In favor of this contention is the period of nonreactivity of the skin to the incorporation of leprous material, an incubation period, which was followed by development of nodules containing lepra bacilli, and vacuolated cells so-called lepra cells. The development of the hard nodules took place in rapid succession in all of the places inoculated at various times and followed the order of the individual inoculations. Then a simultaneous softening and breaking down of the existing lesions took place. This shows an allergic condition because all of the lesions resulting from inoculations performed at various times broke down at once and normal fresh animals of the same species inoculated at the same time and with the same leprous material but for the first time showed not the slightest lesions at the place of inoculations. These findings reminded us so vividly of the conditions we found in the formation of experimental late ulcerative lesions in yaws that we were lead to continue the superinfections for some time after the ulcers in the leprous monkeys have developed and even beyond the period when the lesions began to heal by scar formation. The superinfections, continued beyond the time at which the ulcerative lesions had fully developed,

resulted in the formation of smaller and smaller lesions with each successive inoculation. They no longer developed into spreading ulcerative lesions, and healed rapidly without leaving scars. There is, therefore, in this experiment with leprosy on monkeys a complete duplication of the conditions existing in experimentally inoculated yaws monkeys with late ulcerative yaws lesions, and we may repeat the same statement concerning ulcerative lesions in experiments with leprosy that we made in our study of yaws; that is, the period of time during which ulcerative lesions spring up is limited and is shorter than the duration of the existing ulcerative lesions.

Another phenomenon observed in the course of this experiment and one which may prove to be significant is the relation between the stages of the development of the lesions and the behavior of the acid-fast bacilli encountered in the lesions. In the beginning and while the lesions represented hard cutaneous nodules the acid-fast bacilli were found there in fair numbers, single or in typical bundles. The same forms were found in these lesions as were encountered in the original human material used for inoculation where, likewise, the well-known globi were absent. When the lesions showed the central necrosis and the ulcers formed, single bacilli were still found, a number phagocytized, but typical globi made their appearance, and later in the development of the ulcers they predominated or were found exclusively. About the time the ulcers reached the greatest dimensions and intensity and some time before the healing became noticeable in the form of flattening of the borders and drying of the base, acid-fast bacilli were no longer found in the smears made from the material obtained by scraping the lesions. Nor were they ever found in the lesions that developed as a consequence of inoculations performed after the full development or during the healing of the ulcerative lesions. It would be premature to build speculative theories of immunity or healing in leprosy on these observations, but they appear even at this early time very suggestive.

CONCLUSIONS

1. It has been demonstrated by this experiment that advanced specific lesions can be produced by repeatedly inoculating Philippine monkeys with leprous material, and that the lesions closely resemble certain advanced lesions as known to exist in man. Besides the nodular skin lesions that have been described

by previous workers, necrotic and ulcerative lesions resulted from repeated intracutaneous inoculation with leprous material at the place of inoculation.

2. An allergic condition was observed in one of the two experimental monkeys which resembles in many respects the so-called "lepra reaction," and following this phenomenon there were indications of a gradually increasing resistance expressed by a gradual decrease in size and intensity of the lesions produced in the same animal by subsequent inoculations.

3. A definite relation was noted between the forms and numbers of *B. lepræ* and the stages of development of the advanced local skin lesions.

4. The possibility of studying certain phases of the course of infection in leprosy and of immunity in the broad sense of the word by experimenting on animals is strongly indicated by the results of this preliminary experiment.

5. It is not expected that uniform and constant lesions can be produced in all animals under experimentation. It is rather assumed that in analogy to experimental ulcerative yaws lesions only a certain portion of experimental animals can be induced by superinfection to react to the superinoculation by more-advanced lesions than the mere initial nodular type.

RECORD NOTES

MONKEY LEP. NO. 1

December 31, 1928. Inoculated into both eyebrows and both sides of the nose with a suspension of fresh leprous tissue in salt solution obtained from a lymph gland of a patient who died in an acute lepra reaction.

January 7 and 11, 1929. No sign of lesion.

January 11, 1929. Inoculated into the right eyebrow with leprous material obtained from a lesion of a patient in Sternberg Hospital.

Up to March 14, 1929. No sign of lesion.

March 14, 1929. Distinct pale hard induration on both eyebrows.

March 15, 1929. Microscopic smear made from those lesions shows fair number of acid-fast bacilli, mostly granulated.

March 18, 1929. Same findings as before. A baby was born to the monkey.

March 19, 1929. Material from right eyebrow scraped and used for autoinoculation into left eyebrow (inner canthus). There is a hard infiltration noticeable to-day for the first time at the places of inoculation on both sides of the nose and also at the place of first superinfection on the right outer eyebrow.

March 26, 1929. Photograph 1 taken. Lesions somewhat spreading. The epidermis over the lesions shows superficial paperlike desquamation. The original lesion on the right eyebrow (first inoculation) excised for

sections. The skin upon incision is thickened, pale and soft, slightly bleeding. Smears from the skin after the incision showed very few typical acid-fast bacilli.

April 2, 1929. All the lesions are much softer than before. They are spreading, particularly those on the nose. The lesions show central breaking down. The result is sharply outlined defects with undermined borders. The defects secrete thin grayish yellow pus containing acid-fast bacilli in fair numbers.

April 4, 1929. Photograph 2 taken.

April 5, 1929. The lesions are covered with dry scab. Upon removal of the scab there are sharply outlined defects with granulating base which secretes thin pus. The borders are undermined and indurated. Material collected from all the lesions was used for inoculation of other monkeys and for autoinoculation of Lep. No. 1 on the tip of the nose.

April 8, 1929. All existing lesions were examined and found negative for acid-fast bacilli.

April 12, 1929. All existing lesions were examined as before and found negative for acid-fast bacilli, except the lesion on right eyebrow. Smear from the lesion of right eyebrow showed very few typical acid-fast bacilli and globi.

April 13, 1929. Photograph 3 taken. The ulceration has progressed considerably.

April 15, 1929. All lesions persist. There is a typical hard induration on the tip of the nose at the point of the last injection.

Inoculated on the right eyebrow immediately over the old lesion with human material from San Lazaro patient.

April 19, 1929. All the existing lesions on eyebrows and the bridge of the nose scraped, pooled, suspended in salt solution, and used for inoculation into two guinea pigs.

The smear from the lesions showed very few acid-fast bacilli and globi.

April 23, 1929. All lesions still active, no sign of healing. On the right side of the nose the infiltration is growing. The lesion on the left side of the nose shows spreading margins while the necrotic area is stationary. Inoculated with human material on the left tip of the nose.

May 6, 1929. The lesions on the eyebrows are œdematous and show ichthyotic desquamation. Same finding on both sides of the nose.

The tip of the nose (both sides) shows induration covered with intact skin. Smear from the tip of the nose: Negative for acid-fast bacilli.

May 8, 1929. Photograph 4 taken. The lesions are drying and evidently healing.

There is a small swelling on the right side of the nose covered with intact skin. It contains yellowish pus at the site of the previous injection. Smear was negative for acid-fast bacilli.

May 21, 1929. Lesions on the eyebrows have healed. Alopecia noticeable on the eyebrows, also on the nose.

May 22, 1929. Inoculated in the outer canthus of the right eyebrow with human material from San Lazaro suspended in salt solution containing few granulated lepra bacilli.

June 3, 1929. Old lesions healed by scars. Alopecia at the places of former lesions persists. Inoculations performed after the allergic stage

set in made on the tip of the nose still noticeable as prominent soft swelling. They show no sign of necrosis.

June 15, 1929. The old lesions on the eyebrows and on both sides of the bridge of the nose are healed by scars. The lesions on both sides of the tip of the nose are much smaller and softer. The last injection performed on the outer right canthus of the eyebrow is still elevated and tipped with small scab. The scab removed there is a slight oozing but no pus. Upon incision the tissue is œdematous and very soft. No bleeding occurs. Smear made from this lesion is negative for acid-fast bacilli and globi.

June 17, 1929. The guinea pigs inoculated subcutaneously with material obtained from the lesions of Leprosy No. 1 were killed and autopsied. No change was found at autopsy. The inguinal glands were normal and smears from the glands and spleen failed to reveal acid-fast bacilli.

June 26, 1929. The old lesions are healed, the swelling on the tip of the nose disappeared, and the lesion in the outer canthus of the right eyebrow is smaller and covered with dry scab in the center.

Inoculated in the right eyebrow (inner canthus) with material from San Lazaro.

The material contains a fair amount of acid-fast bacilli mostly in bundles; some solid, some granulated. No globi.

July 1, 1929. There is a slight swelling in the right inner canthus of the place of inoculation. The rest of the lesions are healed by scars. The animal is emaciated and weak.

July 1, 1929. Microscopic: Smear from inner canthus of the right eyebrow was negative for acid-fast bacilli.

July 5, 1929. Found dead. At autopsy; no signs of tuberculosis either macro- or microscopically.

MONKEY LEP. NO. 2

March 21, 1929. Inoculated with human material from a patient (San Lazaro) on both eyebrows.

April 5, 1929. No sign of lesion.

Inoculated with material from Lep. No. 1 into the right outer eyebrow and right ear.

April 8, 1929. No sign of lesion.

Inoculated into the left eyebrow and left bridge of the nose with human material from a patient (San Lazaro).

April 15, 1929. No sign of lesion.

Inoculated in the left eyebrow and left bridge of the nose with leprous material from a patient (San Lazaro).

April 23, 1929. *Distinct hard infiltration at points of previous inoculations.*

Inoculated with human material on the right eyebrow and right ala nasi.

May 6, 1929. Nodules on the sides of the nose and on the eyebrows growing, still hard.

May 21, 1929. There is distinct alopecia over the places of the injection. The hard induration on both sides of the nose and eyebrows persists.

Photograph No. 1 taken.

Smear from the induration on the right side of the nose and the right eyebrow was negative for acid-fast bacilli.

May 22, 1929. Inoculated with human material from San Lazaro suspended in salt solution containing few granulated Lep. bacilli into the right eyebrow and right side of the nose in the neighborhood of the existing lesion.

June 3, 1929. Lesions on eyebrows and sides of nose same as before, firm slightly œdematous. The lesion on the right side of the nose shows whitish superficial skin desquamation.

June 10, 1929. The lesions the same as noted before.

June 15, 1929. The lesions on the eyebrows are flattened. On both sides of the nose is still a hard infiltration particularly on the left side which is slightly bigger than the one on the right.

June 26, 1929. The lesions on the nose and eyebrows still persist. They are rather hard.

Inoculated on both sides of the nose just alongside of the swelling with material from San Lazaro. Also on both eyebrows in the places of the former inoculations.

July 1, 1929. There is a slight swelling at the places of inoculations just above the two nodules on each side of the nose.

Microscopic: Smear from the left side of the nose was negative for acid-fast bacilli.

July 5, 1929. Distinct swelling on both eyebrows and on both sides of the nose at the places of last injection. On the left side below the last injection slight desquamation. Microscopic: Smear from the swelling of the right eyebrow was negative for acid-fast bacilli.

July 16, 1929. There is a distinct hard induration in both eyebrows and both sides of the nose just above the penultimate inoculation which is characteristic on the left side by white scar.

Inoculated in the outer canthus of both eyebrows with leprous material from San Lazaro.

July 23, 1929. Small indurations on both sides of the nose and nothing particular on the eyebrows except a symmetric swelling over the inner canthus which is not very hard and slightly decolorized.

August 2, 1929. Condition same as July 23, 1929.

August 29, 1929. Faint whitish scars at places of healed lesions.

ILLUSTRATIONS

PLATE 1

Lep. No. 2. Initial local nodules are shown. They developed at the places of inoculations with human leprous material.

PLATE 2

Lep. No. 1. The initial nodules spread out towards the periphery. They became soft and the skin covering the lesions became thin and showed ichthyotic desquamation.

PLATE 3

Lep. No. 1. The lesions underwent suddenly a simultaneous change. The central part of the lesions showed extensive necrosis and the skin covering the lesions turned into a tenacious dark leatherlike scab. Note a drop of thin grayish pus escaping from the detached part of the crust of the lesion located on the external part of the right eyebrow.

PLATE 4

Lep. No. 1. Upon removal of the crust the lesions appeared as sharply outlined ulcers with slightly undermined borders and granulating base which secreted thin grayish pus mixed with minute streaks of blood. Below the big ulcer on the right side of the nose, a typical nodule is seen.

PLATE 5

Lep. No. 1. Healing by cicatrization is in progress.

PLATE 6

Lep. No. 1. Lesions completely healed. The outer part of the right eyebrow shows remnant of a nodule the consequence of the last inoculation.

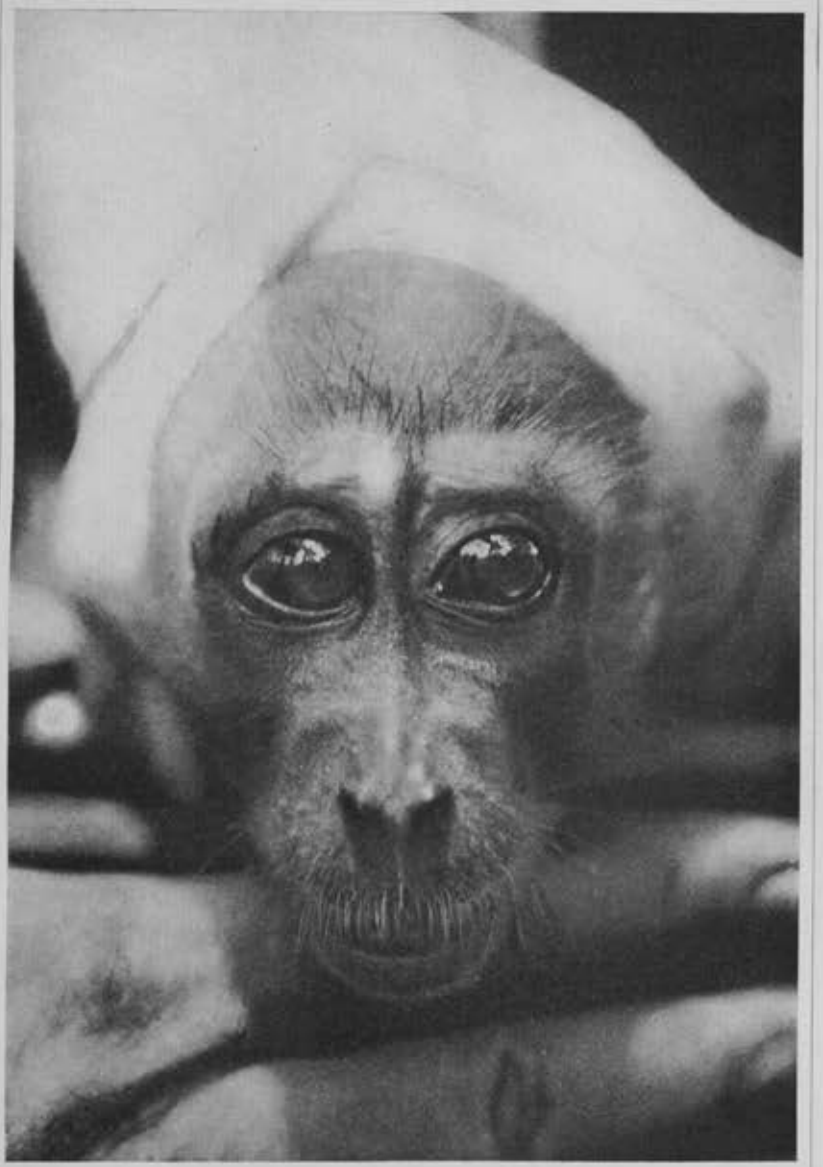


PLATE 1.

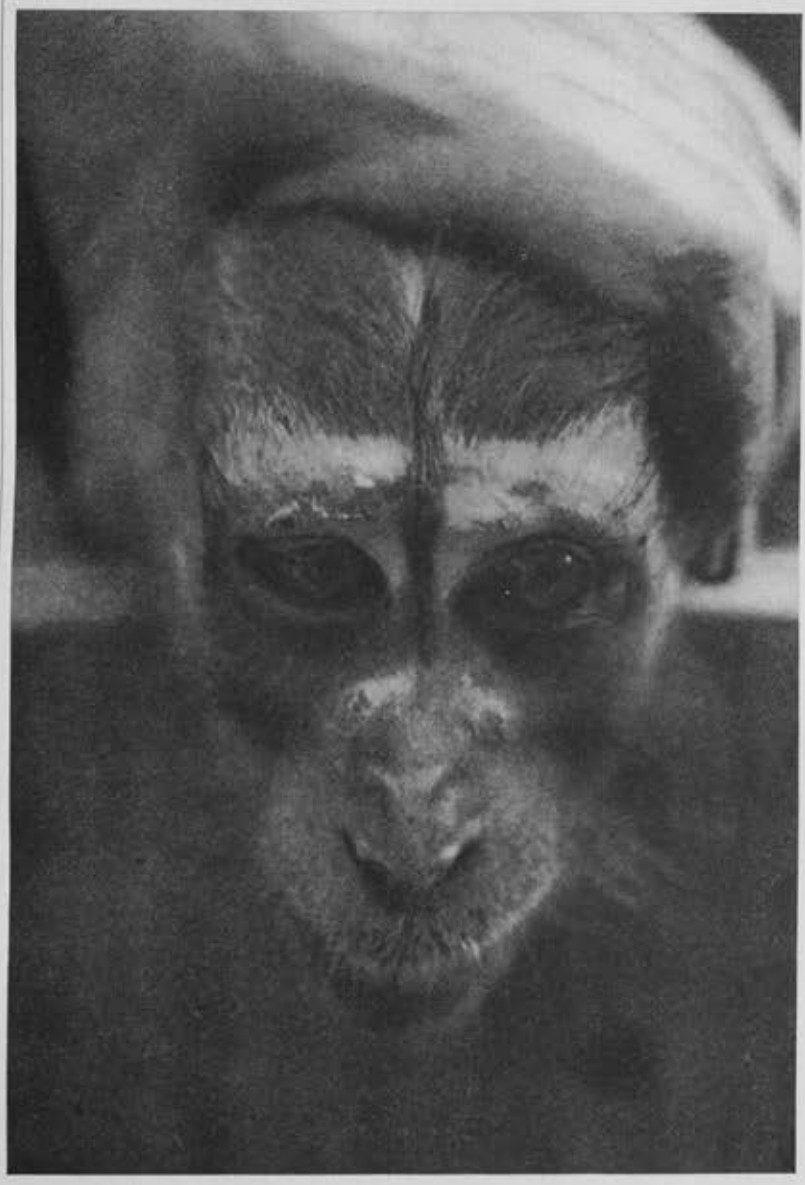


PLATE 2.

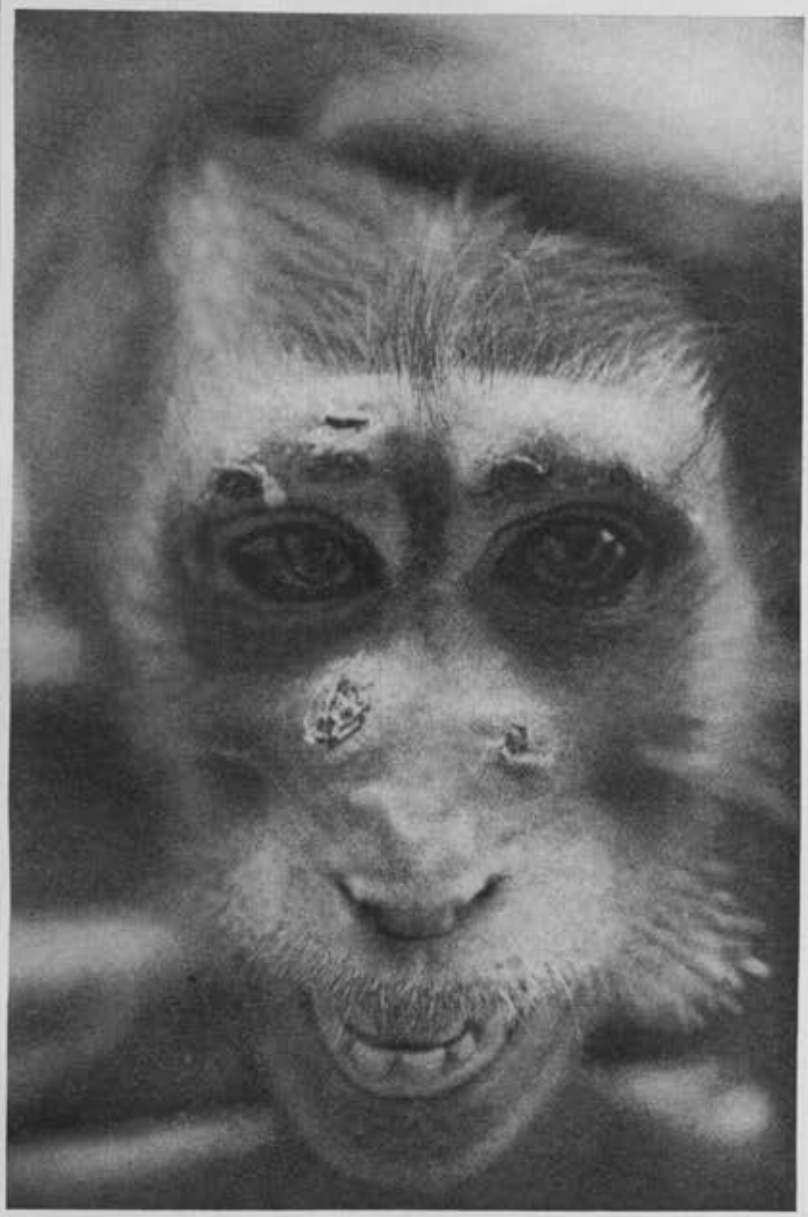


PLATE 3.

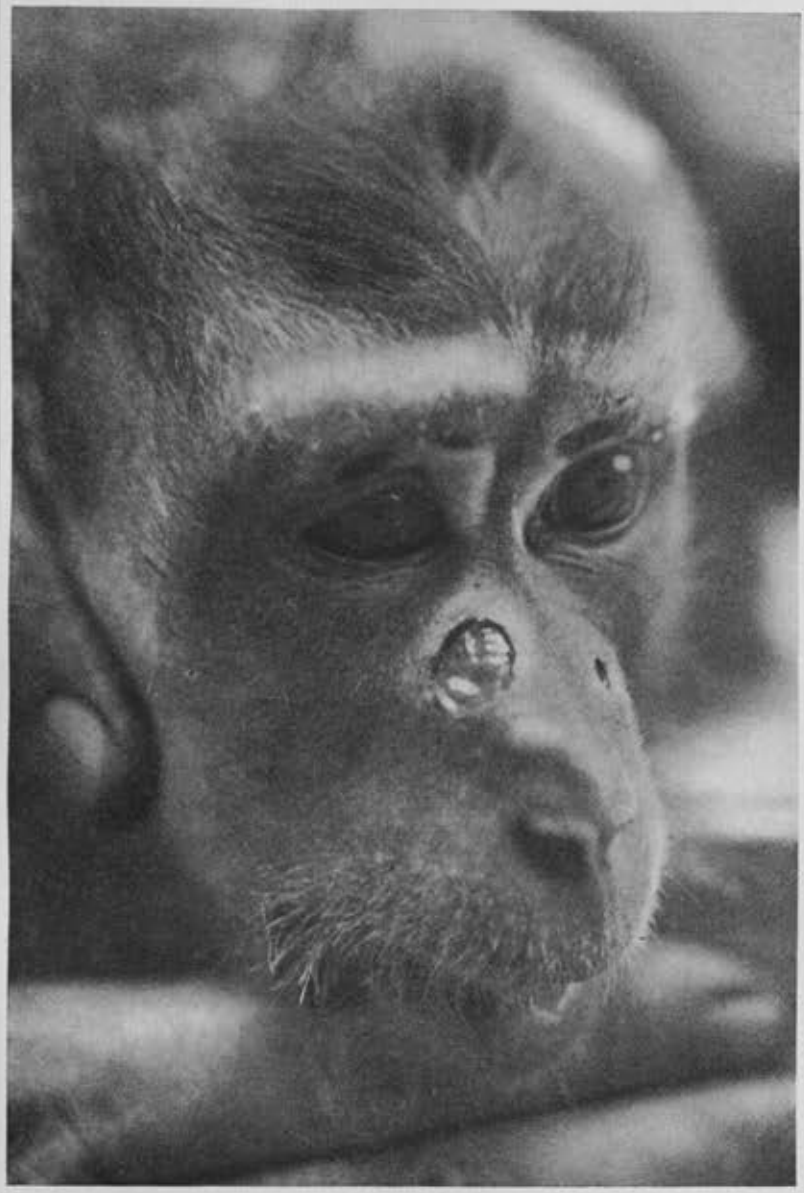


PLATE 4.

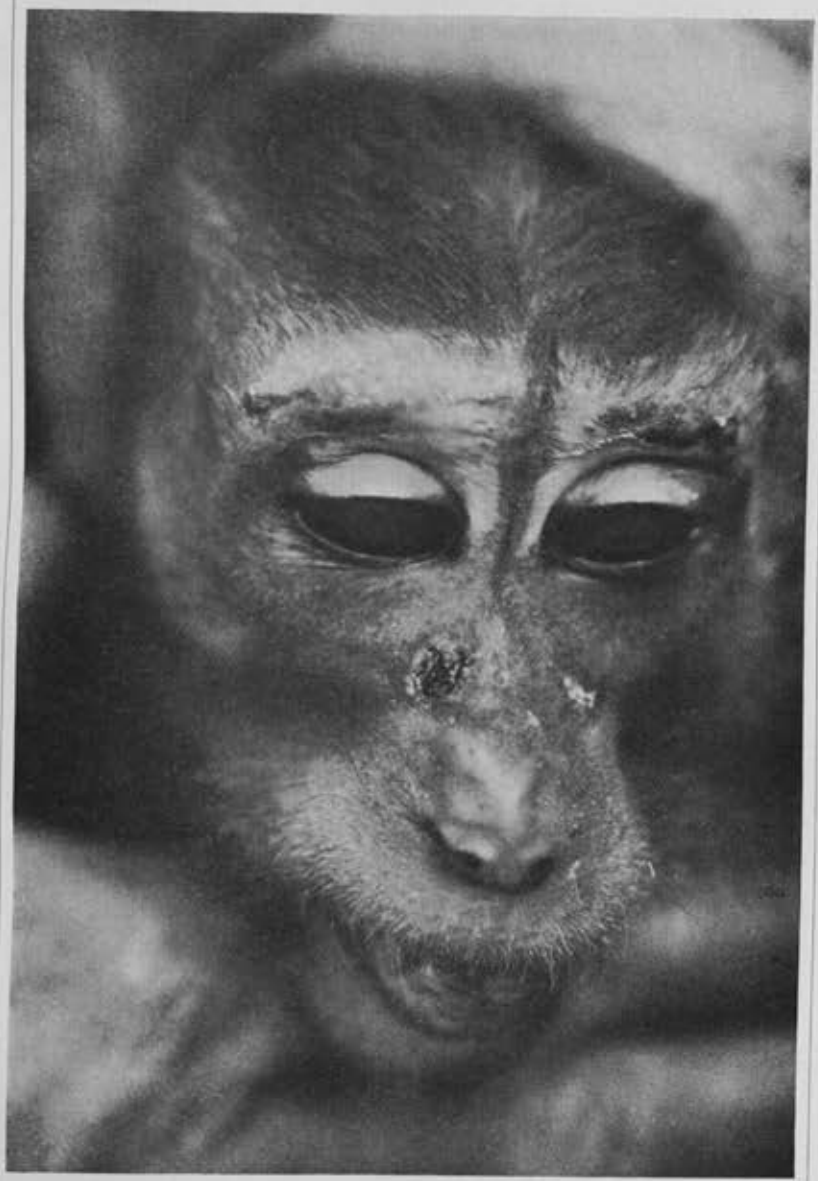


PLATE 5.

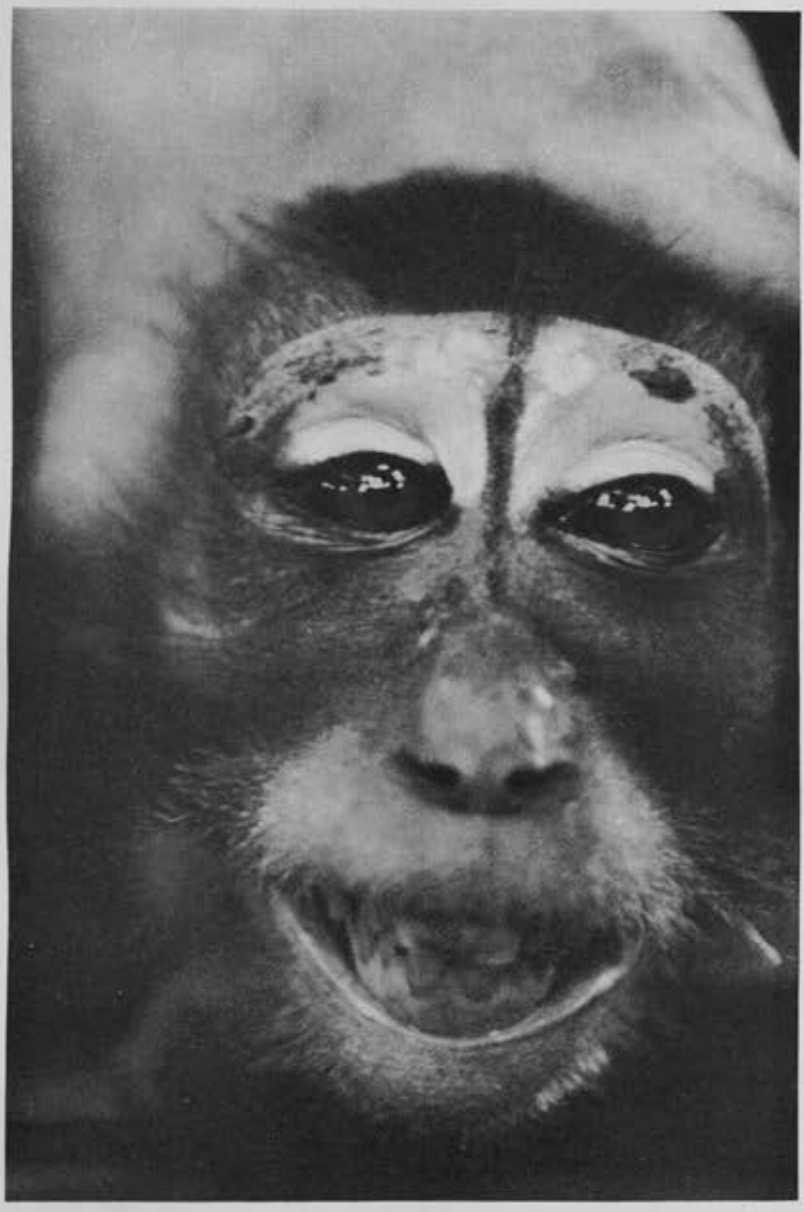


PLATE 6.

STATISTICS AND TESTS OF GASOLINE MARKETED IN THE PHILIPPINE ISLANDS

By RAY N. ALLEN

Chemist, Bureau of Science, Manila

SIX TEXT FIGURES

With the present extended use of the automobile the economic importance of the oil industry has become of general interest. Gasoline is one of the most important products obtained from petroleum.

The United States Bureau of Mines has published a number of reports concerning various aspects of the gasoline marketed in the United States.[1]

The purpose of this paper is to present data on the quality of the gasoline used in the Philippine Islands, together with a brief consideration of some of the factors concerned in its distribution. The viewpoint of the automobile owner has been kept in mind and an attempt has been made to make this article a source of helpful information to him.

Although traces of oil have been found in the Philippines and some prospect drilling has been done, as yet no oil has been produced commercially. Whether oil exists in sufficient quantities in the Islands to justify the prediction that it may be produced on a commercial scale cannot be said. As a conse-

[1] Rittman, W. F., and E. W. Dean, The Analytical Distillation of Petroleum, U. S. Bur. of Mines Bull. 125 (1916).

Rittman, W. F., W. A. Jacobs, and E. W. Dean, Physical and Chemical Properties of Gasolines sold throughout the United States during the calendar year 1915, U. S. Bur. of Mines Technical Paper 163 (1916).

Dean, E. W., Motor Gasoline Properties, Laboratory Methods of Testing, and Practical Specifications, U. S. Bur. of Mines Technical Paper 214 (1919).

Hill, H. H., and E. W. Dean, Quality of Gasoline Marketed in the United States, U. S. Bur. of Mines Bull. 191 (1920).

Kraemer, A. J., Manufacture and Characteristics of Gasoline, U. S. Bur. of Mines Information Circular 6006 (April, 1926).

Hopkins, G. R., Petroleum Refinery Statistics, 1927, U. S. Bur. of Mines Bull. 297 (1929).

quence the petroleum products used in the Philippines are imported, mainly from the United States and the Dutch East Indies. The relative quantities of gasoline imported from these two sources are presented graphically in fig. 1.

With the exception of the postwar business depression in 1922 the number of cars and trucks has increased steadily until in 1928 a total number of 28,848 [2] were licensed. The curves in fig. 2 illustrate this increase.

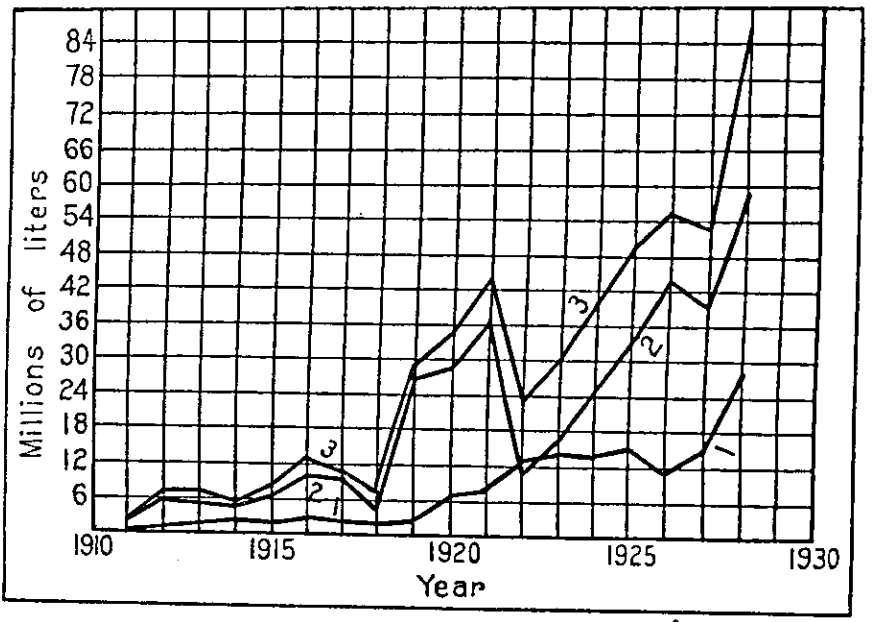


FIG. 1. Imports of gasoline into the Philippines, by years. Curve 1. Gasoline imported from the Dutch East Indies. Curve 2. Gasoline imported from the United States. Curve 3. Total gasoline imported. Data from annual reports of the Insular Collector of Customs.

Petroleum is a complex mixture of substances which may be separated by distillation into various commercial products such as petroleum ether, gasoline, kerosene, lubricating oils, paraffin, etc. Gasoline, which is a mixture of the simpler aliphatic hydrocarbons, is at present obtained from three sources: fractional distillation of the crude petroleum, condensation from natural gas, and "cracking" of heavier oils.

The need for gasoline has increased far more rapidly than has the production of crude oil, and in consequence the refineries

[2] Philippine Bureau of Commerce and Industry.

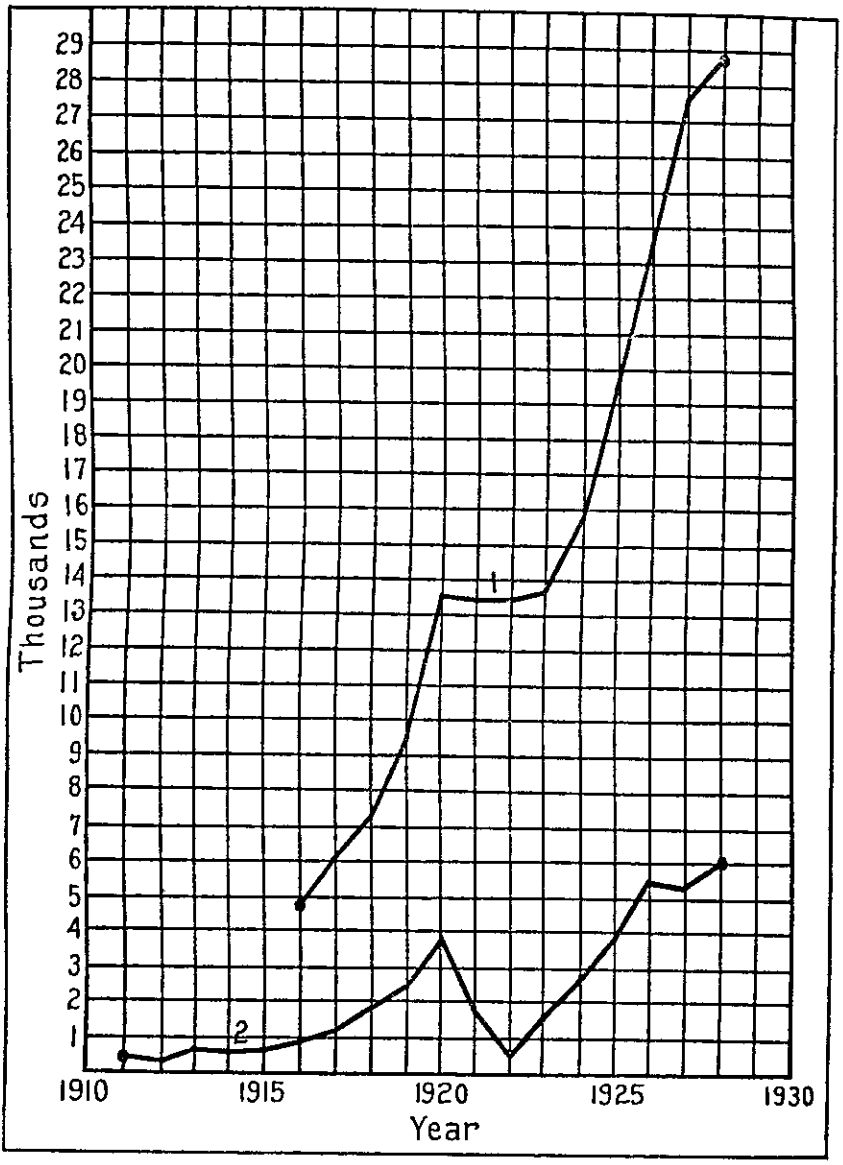


FIG. 2. Curve 1. Cars and trucks registered in the Philippines, by years. Data from Statistical Bulletin of the Philippine Islands, published annually by the Bureau of Commerce and Industry. Curve 2. Cars and trucks imported into the Philippines, by years. Data from annual reports of the Insular Collector of Customs.

for many years have not been able to produce enough "straight-run" gasoline to supply this demand. When the shortage first became apparent it was met by "cutting deeper into the crude;" that is to say, the upper boiling point of the gasoline cut was

extended to include some of the lower part of the former naphtha-kerosene range.

When this additional supply failed to suffice, processes were developed for condensing the very light "casing-head gasoline" out of natural gas by means of compression, absorption, or adsorption. Casing-head gasoline is very volatile, too much so for use by itself in automobiles, but it can be mixed with other fractions which would be too "heavy" to use by themselves, and the resulting "blended" gasoline becomes a very satisfactory fuel. Because of its volatility the use of casing-head gasoline permits easy starting of the engine.

The third source of gasoline is from the cracking of heavy oils by heat and pressure, a process first introduced to the industry by Dr. W. M. Burton. Cracked gasoline is usually blended with other gasoline. The use of casing-head and cracked gasolines has enabled the refiners to maintain a supply of gasoline to meet the increased demand. Hill and Dean [3] state that a large part of the gasoline sold in the United States is of the blended type. There was a long controversy as to the relative merits of straight-run gasolines and those produced by cracking processes. The original demand was for a "high test" straight-run fuel, but the ever increasing number of motor vehicles forced the production and sale of the blended products through economic necessity and without regard to the consumer's preference. The use of cracked gasoline in turn caused or, at least, helped the development of the present-day high-compression motor, so that even if straight-run gasoline may have been preferable at one time, to-day its superiority is problematical. It is stated [4] that cracked gasolines cause less knocking in motors and that because they can be used in high-compression engines they develop 10 to 20 per cent more power. The self-starter, hot-spot manifolds, and intake heaters also are developments which permit the use of less-volatile gasolines to-day than were formerly necessary as Hill and Dean [5] have pointed out.

The use of substitutes for gasoline as motor fuel is at present not great, but since the supply of gasoline is limited, while the potential production of alcohol is unlimited, it is apparent that the question of the use of fuels other than petroleum in internal-combustion engines may in time become of great economic im-

[3] U. S. Bur. of Mines Bull. 191: 5 and 62.
[4] Chemical Abstracts 20 (1926) 2581.
[5] U. S. Bur. of Mines Bull. 191 (1920) 20.

portance. Two classes of substitutes are available; namely, by-products from coke-ovens, such as benzol and toluol, and alcohol derived from plant sources. Of the two, the by-products of the coke oven (in admixture with gasoline) are at present most widely used. The use of alcohol is of greater future significance, but neither constitutes at present more than two or three per cent of the total automobile fuel marketed.

Blends of gasoline or kerosene with benzol or alcohol are not sold in the Philippines. Alcohol itself is used in tractors on some of the haciendas, but, except in a relatively few instances, automobiles have not been adapted to its use. Cole [6] has investigated the subject and recommends the production and use in the Islands of a motor fuel such as "Natalite," a patented product, the composition of which is given by him as:

	Per cent.
Ethyl alcohol (95 per cent)	55.0
Ether	44.9
Ammonia	0.1

Fuel of this type can be used in existing automobile engines with a few minor changes and adjustments of the machinery, and it is stated by Cole, among other advantages, that it gives approximately the same mileage as gasoline, that it knocks less, and that it burns without the formation of carbon. There also is said to be less fouling of spark plugs and lower consumption of oil.

Ellis and Meigs [7] cite a report stating that during the war a motor fuel was produced in South Africa and subsequently in Hawaii which proved to be equal to the best quality of gasoline available. The fuel referred to was Natalite.

Leslie [8] discusses Natalite and says that in places where the hydrocarbon fuels are not available Natalite or some similar mixture should be commercially important. Both Cole and Leslie give references to the literature.

Gasoline is sold at a considerably higher price in the Philippines than in the United States. The present (1929) retail price at pumps in Manila is 20 centavos per liter or approximately 38 cents (United States currency) per gallon, while the selling price of gasoline in the United States is usually between 18 and 25 cents per gallon. The higher cost in the

[6] Philip. Journ. Sci. 21 (1922) 17.
[7] Gasoline and Other Motor Fuels (1921) 547.
[8] Motor Fuels (1923) 513.

Philippines is due to a combination of several factors, among which are the long shipping distance, the high evaporation loss from tank storage, the distribution of a great part of the gasoline in cases and drums, the internal revenue tax of 4 centavos per liter (approximately 0.075 dollar United States currency per gallon), and perhaps, also, because a higher quality of gasoline is sent to the Islands than is marketed in the United States. The local price of gasoline exhibits few fluctuations.

The specifications and tests used by the Bureau of Science in determining the quality of gasoline are those of the United States Government.[9]

The most important single means for the indication of the properties and quality of gasoline is the distillation test. The method consists in distilling a sample of gasoline at a constant rate into a graduated receiver and noting the temperatures at which various fractions are received. The apparatus is standardized and the details of manipulation are carefully specified to ensure uniform results.

One hundred cubic centimeters of the gasoline to be tested are placed in the distillation flask, a thermometer and cork are inserted in the neck of the flask, and the side-arm connected to the copper condenser which is cooled with ice and water. Heat is applied to the flask by means of a gas burner or an electric heater so that the first drop of distillate falls from the condenser in from five to ten minutes. When this first drop falls the temperature shown by the thermometer is read and recorded as the "initial boiling point" of the gasoline. Additional readings of the thermometer are taken as the distillate reaches the successive 10-cubic-centimeter divisions of the graduated receiver and are recorded as the distilling temperatures of 10 per cent fractions of the sample. When the distillation is practically complete the temperature rises rather rapidly to a maximum and then begins to fall. The highest reading is recorded as the "end point." The "recovery" of distillate and the volume of the "residue" left in the distillation flask are measured and recorded and the difference between their sum and one hundred, the volume of the sample taken at the beginning of the test, is recorded as the "distillation loss."

[9] United States Government Master Specification for Lubricants and Liquid Fuels and Methods for Sampling and Testing, U. S. Bur. of Mines Technical Paper 323 B (1927).

The United States Government specifications for motor gasoline fix limits for the initial boiling point, the 20 per cent, 50 per cent, and 90 per cent points, and the end point, as well as the recovery. In addition, the absence of water and suspended matter are required and limits are fixed for corrosiveness and sulphur content. Specific gravity or Baumé gravity are not mentioned since they mean little unless the source of the crude oil and the process of manufacture are known. The requirements imposed are purposely broad enough to include any properly refined gasoline suitable for use in motor vehicles, whether cracked or straight-run and irrespective of the source of the crude oil from which it was made.

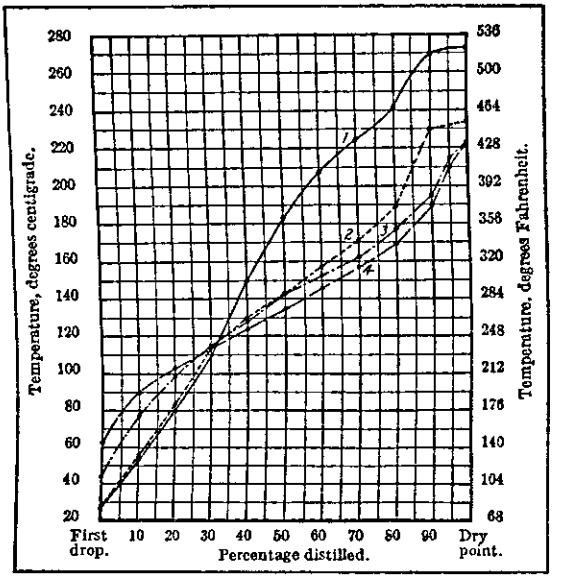


FIG. 3. Distillation curves characteristic of different types of blended casing-head gasoline with a "straight" refinery gasoline. *1*, Blend with kerosene; *2*, blend with naphtha; *3*, "heavy" gasoline; 4, "straight" refinery gasoline. Reproduced from U. S. Bureau of Mines Bulletin 191.

The differing distillation characteristics of gasolines from varying sources are illustrated by the curves in fig. 3, which is reproduced from the paper of Hill and Dean [10] on United States gasolines.

From such curves the nature of gasoline can be determined. A low initial boiling point and an approximately straight graph indicate a casing-head blend. A sharp break around the 20 per cent point and a comparatively flat intermediate range are characteristic of straight-run gasoline.

The distillation curves of gasolines sold in the Philippines were plotted from the tests of seventy-six samples of gasoline

[10] U. S. Bur. of Mines Bull. 191 (1920).

submitted during the past six years to the Bureau of Science for routine analysis. While the analyses were rather few in number, they probably were representative, since most of the gasoline sold in the Islands was entered in the port of Manila and was handled almost exclusively by a few large companies. The analyses were made by experienced workers who have carried on the routine petroleum analysis at the Bureau of Science.

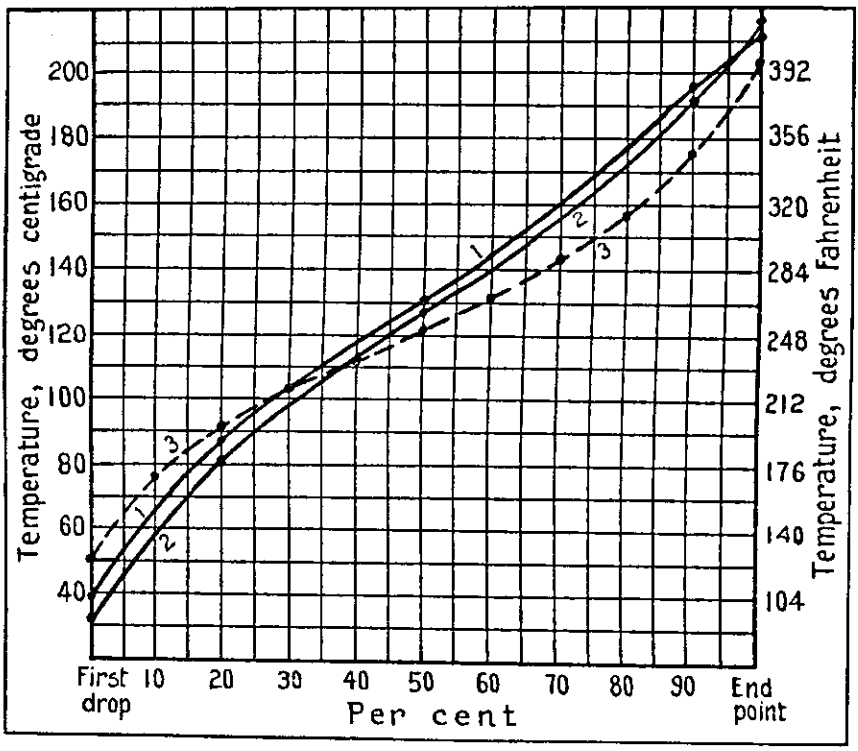


FIG. 4. Curve 1. Distillation curve of average of gasoline sold in the United States, Summer, 1928. Curve 2. Distillation curve of average of gasoline sold in the United States, Winter, 1928. Curve 3. Distillation curve of average of gasoline sold in the Philippines during 1927–1928–1929. Data for the United States gasolines from U. S. Bureau of Mines Bulletin 297.

Since 1926 these tests have been made by the writer. All of the distillations were done according to the standard methods of the United States Bureau of Mines.

The gasoline situation in the Philippines differs from that in the United States in that a considerable amount of the gasoline sold here is unblended straight-run material. A comparison of the average of all the gasolines sold in the American

market in winter and in summer with the average of those sold in the Philippines is given for the year 1928 by the distillation curves in fig. 4. To obtain more nearly representative figures the Philippine analyses for the years 1927, 1928, and 1929 were averaged. There was little change in the characteristics of the gasoline sold during that period, so that this means was taken to get the average of a larger number of samples. The American analyses are from Hopkins.[11]

It will be noted that the gasoline of the Philippine market showed a higher initial boiling point, which is in harmony with the requirements in a region where the temperature is never lower than 65° F. and averages around 80° F. The lessened quantity of low-boiling fractions decreases the evaporation loss though still permitting easy starting. It is also evident that a larger proportion of the desirable intermediate boiling fractions was present. The average end point of the gasolines sold in the United States in January, 1928, has been given by Hopkins [12] as 416° F. and in July, 1928, as 413° F. There obviously is no requirement for specific summer and winter gasolines in the Philippine market. The same grade is sold throughout the year. From reference to fig. 4 it will be seen that in the case of the gasolines sold in the Philippines in 1929 the average of the end points was somewhat lower than it was in those furnished the American market and may be stated to have been approximately 400° F. This was a desirable quality since it insured quicker and cleaner burning in the engine with less dilution of the crank-case oil by unburned heavy ends. Assuming that the samples analyzed were representative of the gasoline distributed in the Philippines, the results of these tests, as shown by the graphs in fig. 4, would seem to indicate that the gasolines sold in the Islands were of somewhat higher quality than those marketed in the United States.

All of the gasolines tested for acidity and sulphur passed the United States Government requirements, and it is almost axiomatic that any properly refined gasoline is free from water and foreign matter. The color of the gasolines tested varied from water-white to a faint yellow, but this is more a matter of the degree of drastic refining to which the gasoline is subjected than a criterion of actual quality. Cracked gasoline often has a slightly disagreeable characteristic odor, but this has little

[11] U. S. Bur. of Mines Bull. 297 (1929) table on p. 74.
[12] Op. cit.

to do with the performance of the gasoline in an engine. The popular demand has been for water-white gasoline of sweetish ethereal odor and the manufacturers meet this demand as much as is consistent with a maximum production of gasoline from the crude oil.

The distillation characteristics of four of the leading brands of gasoline sold in the Philippines in 1929 are reproduced in fig. 5. For obvious reasons, the brands may not be named in

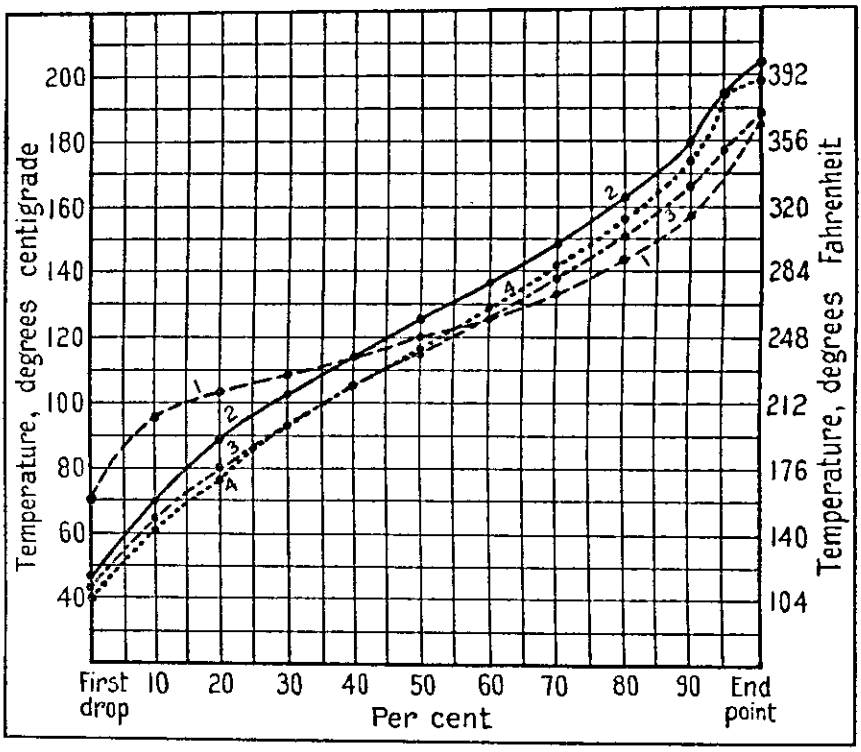


FIG. 5. Distillation curves of four leading brands of gasoline marketed in the Philippines in 1929.

a paper of this nature. Brand 1 was a typical 100 per cent straight-run gasoline, while Brands 2, 3, and 4 indicated the admixture of casing-head gasoline to increase the volatility of blended products. It would be difficult and unfair to state that any one of these was either superior or inferior to the others for automobile fuel, since all were gasolines of excellent quality.

A slight change in the characteristics of gasoline in the past six years is apparent from the curves in fig. 6, which gives the

composite distillations of the leading brands in two three-year groups. The difference is comparatively unimportant and it cannot be stated that the quality had suffered appreciably; in fact, the increased use of high-compression motors since 1926 has more than justified the higher boiling points shown in the upper ranges of the curve for 1927, 1928, and 1929.

SUMMARY

Statistics are given regarding gasoline in the Philippine Islands. The standard laboratory method of testing gasoline is described in detail for the information of the automobile owner.

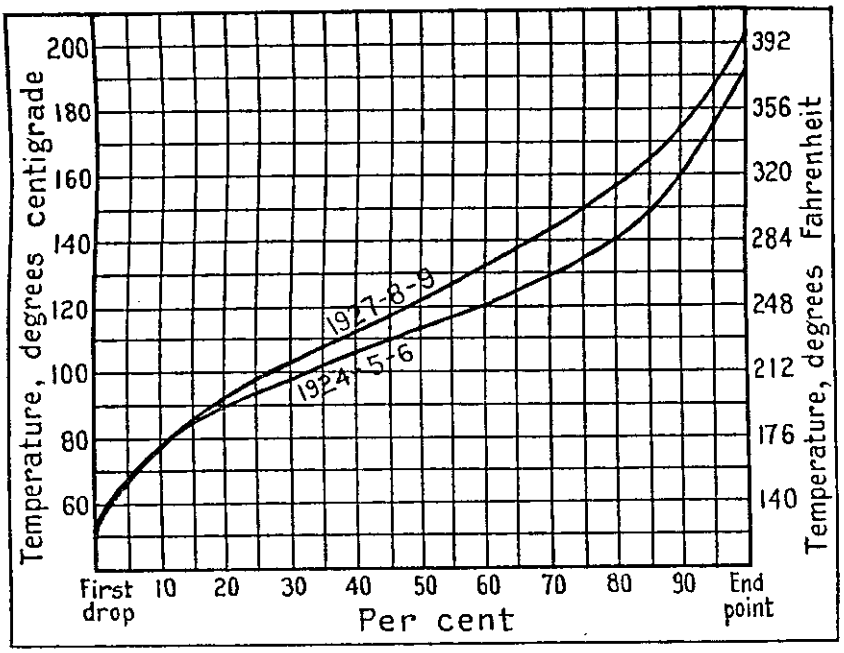


FIG. 6. Distillation curves of average of gasolines sold in the Philippines, 1924–1929.

The analyses of seventy-six samples, as tested by the writer and his predecessors, are summarized. Comparison of the results of these tests with those obtained by the United States Bureau of Mines on gasoline marketed in the United States is given.

Assuming that the samples analyzed are representative of the gasoline marketed in the Philippines, the results of these tests would seem to indicate that a better average quality of gasoline is sold in the Philippine market than is retailed in the United States.

ILLUSTRATIONS

TEXT FIGURES

FIG. 1. Imports of gasoline into the Philippines, by years.
Curve 1. Gasoline imported from the Dutch East Indies.
Curve 2. Gasoline imported from the United States.
Curve 3. Total gasoline imported.
Data from annual reports of the Insular Collector of Customs.
2. Curve 1. Cars and trucks registered in the Philippines, by years.
Data from Statistical Bulletin of the Philippine Islands, published annually by the Bureau of Commerce and Industry.
Curve 2. Cars and trucks imported into the Philippines, by years.
Data from annual reports of the Insular Collector of Customs.
3. Distillation curves characteristic of different types of blended casing-head gasoline with a "straight" refinery gasoline; *1*, blend with kerosene; *2*, blend with naphtha; *3*, "heavy" gasoline; *4*, "straight" refinery gasoline. Reproduced from U. S. Bureau of Mines Bulletin 191.
4. Curve 1. Distillation curve of average of gasoline sold in the United States, summer, 1928.
Curve 2. Distillation curve of average of gasoline sold in the United States, winter, 1928.
Curve 3. Distillation curve of average of gasoline sold in the Philippines, 1927–1929.
Data for the United States gasolines from U. S. Bureau of Mines Bulletin 297.
5. Distillation curves of four leading brands of gasoline marketed in the Philippines in 1929.
6. Distillation curves of average of gasolines sold in the Philippines, 1924–1929.

HELMINTH PARASITES OF MAMMALS IN THE PHILIPPINE ISLANDS [1]

By EVERETT E. WEHR

Of the University of Illinois, Urbana

Through the courtesy of Dr. Henry B. Ward, the writer was permitted during the summer of 1928 to work over a small collection of parasites sent to him by Marcos A. Tubangui from the Philippine Islands. These parasites which consisted chiefly of nematode parasites were collected from domesticated animals in the vicinity of Los Baños, Laguna Province, Luzon. The majority of the helminth parasites listed in this paper have been reported from the Philippines by previous writers; namely, Schwartz (June, 1925), Schwartz and Cram (August, 1925), and Tubangui (September, 1925). The writer has been able to add to the lists of these writers four other species of nematodes that have not been reported from the Philippines.

In this paper no attempt has been made to list all the known species of nematode parasites from mammals in the Philippine Islands; only those species contained in the collection of which a study has been made are included. Hence this paper does not, in any way, supplement previous publications on helminth parasites from the Philippines.

PLATYHELMINTHES

TREMATODA

DICROCŒLIIDÆ

DICROCŒLIINÆ

Genus EURYTREMA Looss, 1907

EURYTREMA OVIS Tubangui, 1925.

Collected from the fat surrounding the rectum of sheep. A description of this parasite is given by Tubangui (1925).

[1] Contribution from the zoölogical department of the University of Illinois, under the direction of Henry B. Ward.

CESTODA

ANOPLOCEPHALIDÆ

ANOPLOCEPHALINÆ

Genus ANOPLOCEPHALA E. Blanchard, 1848

ANOPLOCEPHALA PERFOLIATA (Goeze, 1782).

This striking species was collected from the cæcum of the horse. Tubangui (1925) records this species as being collected also from the ileum and colon of the same host.

NEMATHELMINTHES

NEMATODA

TRICHURIDÆ

TRICHURINÆ

Genus TRICHURIS Roederer, 1761

TRICHURIS OVIS (Abildg., 1795).

This species was collected from the intestine of a Hereford calf and from the cæcum of a goat.

STRONGYLIDÆ

STRONGYLINÆ

Genus STRONGYLUS Mueller, 1780, or Goeze, 1782

STRONGYLUS EDENTATUS (Looss, 1900).

Schwartz (1925) says that this is the most abundant species of the genus found in the horse in the Philippine Islands.

Collected from the floating colon and large intestine of the horse.

STRONGYLUS VULGARIS (Looss, 1900).

This is the smallest of the three species of the genus *Strongylus*. It is responsible for the formation of verminous aneurisms in the Equidæ.

Collected from the floating colon and the large intestine of horses.

Genus TRIODONTOPHORUS Looss, 1902

TRIODONTOPHORUS INTERMEDIUS Sweet, 1909.

This species is easily distinguished from the following species of the same genus by means of the short median lobe of the bursa copulatrix, the denticulated anterior margin of the teeth of the œsophageal funnel, and the greater distance from the vulva to the posterior end of the body.

Collected from the floating colon and the large intestine of the native horse.

TRIODONTOPHORUS MINOR (Looss, 1900).

Writers have noted that this species inhabits the anterior portion of the colon and the cæcum, whereas *intermedius* prefers the posterior portion of the colon.

Collected from the floating colon and the large intestine of the native horse.

Genus GLOBOCEPHALUS Molin, 1861

GLOBOCEPHALUS LONGEMUCRONATUS Molin, 1861.

This parasite apparently has not become definitely established as a distinct species. The morphology of the specimens examined by the writer agrees with the morphology of the specimens examined by Tubangui, in that the mouth capsule is cylindrical and contains no teeth.

Collected from the small intestine of the pig.

GLOBOCEPHALUS SAMOENSIS (Lane, 1922).

Yorke and Maplestone (1926) state that possibly this species is identical with *G. longemucronatus*. They give as their reason that "practically the only difference being that in Molin's species subventral lancets are not figured in the buccal capsule, but these may easily have escaped observation." The specimen which the writer has determined as this species contains within the buccal cavity well-developed bicuspid teeth, just as Lane has observed.

Raillietstrongylus samoensis (Lane, 1922) Lane, 1923, is a synonym of this species.

GLOBOCEPHALUS UROSUBULATUS (Alessandrini, 1909).

This species contains within the mouth capsule a pair of rudimentary basal subventral teeth, the dorsal lobe of the bursa of the male is small, the dorsal rays of the bursa are united for about three-fourths of their lengths, and the accessory piece is somewhat canoe-shaped in lateral view.

Collected from the intestine of the pig.

STEPHANURINÆ

Genus STEPHANURUS Diesing, 1839

STEPHANURUS DENTATUS Diesing, 1839.

This species is commonly known as the kidney worm of swine. Tubangui (1925) says that this species is often responsible for the high rate of mortality among pigs in the Philippine Islands.

Collected from the kidney of swine.

TRICHONEMINÆ

Genus TRICHONEMA Cobbold, 1874

TRICHONEMA BICORONATUM (Looss, 1900).

Only a few specimens of this species were present in the collection. Schwartz (1925) reports that this species was not found in large numbers in horses of the Philippine Islands.

This species has the elements of the internal leaf crown all equally long, and in the female there is a prominence in front of and covering the vulva.

TRICHONEMA CALICATUM (Looss, 1900).

The œsophagus, according to Ihle (1922), measures from 290 to 300 microns in length. The median lobe of the bursa copulatrix is long, and the external leaf crown does not exceed ten elements in number.

TRICHONEMA CATINATUM (Looss, 1900).

The mouth capsule is wider anteriorly than posteriorly when seen in lateral view, and the appendages of the genital cone are notched and rounded at the extremities.

Numerous in the small colon and large intestine of the native horse.

TRICHONEMA CATINATUM var. PSEUDOCATINATUM (Yorke and Macfie, 1920).

Yorke and Macfie (1920) believed that this is a species. Ihle (1922) considered it as a variety of *catinatum*, differing from the latter mainly in that each appendage of the genital cone bears two conical processes.

Very abundant in the large intestine of the native horse.

TRICHONEMA CORONATUM (Looss, 1900).

The mouth capsule is cylindrical and the appendages of the genital cone bear numerous finger-shaped processes.

A few collected from the intestine of the native horse.

TRICHONEMA ELONGATUM (Looss, 1900).

There were only a few specimens of this parasite.

This form belongs to the *radiatum-elongatum* group of Ihle (1922). Its most striking characteristic is the thin, but very long œsophagus.

Collected from the large intestine of the native horse.

TRICHONEMA EUPROCTUS (Boulenger, 1917).

Schwartz (1925) reported a male and a female in copula from the colon of a Philippine horse. The writer had the op-

portunity to examine only a few females of this species. The male, according to Ihle, has a genital cone of extraordinary length. The posterior extremity of the female is straight.

Collected from the large intestine of the native horse.

TRICHONEMA GOLDI (Boulenger, 1917).

This form belongs to the *alveatum-catinatum* group of Ihle (1922). The mouth capsule is narrower anteriorly than posteriorly when seen in lateral view, and the appendages of the genital cone generally bear two finger-shaped processes. Each of the radial plates of the œsophageal funnel terminates in a tooth.

Collected from the small colon and the large intestine of the native horse.

TRICHONEMA GOLDI var. TRIDENTATUM (Yorke and Macfie, 1920).

This was believed to be a species by Yorke and Macfie, but Ihle (1922) considered it a variety of *goldi*. It differs from *goldi* chiefly in the absence of the appendages of the genital cone.

Collected from the large intestine of the native horse.

TRICHONEMA INSIGNE (Boulenger, 1917).

According to Ihle (1922) the male measures from 11 to 12.5 millimeters in length and the female 13.5 to 15.0 millimeters. The number of the elements in the external leaf-crown varies widely. According to Ihle there are from 36 to 48, whereas Boulenger counted from 32 to 36.

Collected from the large intestine of the native horse.

TRICHONEMA LONGIBURSATUM (Yorke and Macfie, 1918).

This form belongs to the *calicatum* group of Ihle (1922). The mouth capsule is narrowed anteriorly, and the median lobe of the bursa copulatrix of the male is extraordinarily long.

Collected from the small colon and the large intestine of the native horse.

TRICHONEMA NASSATUM (Looss, 1900).

This and the following species are somewhat difficult to separate. According to Yorke and Macfie, *nasatum* var. *parvum* is indistinguishable from *nassatum* except for its smaller size and the possession of a constant accessory side branch on ray D_3.

Collected from the large intestine of the native horse.

TRICHONEMA NASSATUM (Looss, 1900) var. PARVUM (Yorke and Macfie, 1918).

There were numerous specimens available for study, indicating that this species occurs frequently in horses of the Philippine Islands.

Collected from the small colon and the large intestine of the native horse.

TRICHONEMA PATERATUM (Yorke and Macfie, 1919).

This species is reported for the first time as occurring in horses in the Philippine Islands.

It has been found in horses in the United States by Yorke and Macfie and by Riley, in Hungary by Kotlan, in India by Boulenger, and in Holland by Ihle.

Collected from the large intestine of the native horse.

TRICHONEMA RADIATUM (Looss, 1900).

This species is reported for the first time as a parasite of horses in the Philippine Islands. Its range, thus far, has been limited to Egypt (Looss) and Canada (Ransom and Hadwen).

Collected from the large intestine of the native horse.

TRICHONEMA ULTRAJECTINUM (Ihle, 1920).

This is the first report of the occurrence of this species as an equine parasite in the Philippine Islands.

The external leaf crown consists of 10 to 12 large and broad elements with curved tips. The elements of the internal leaf crown are numerous, 10 or 12 of which, according to Ihle (1922), are very pointed and strongly elongated.

Collected from the large intestine of the native horse.

Genus POTERIOSTOMUM Quiel, 1919

POTERIOSTOMUM IMPARIDENTATUM Quiel, 1919.

This and the following species are closely related; in fact, Kotlan (1921) considered this species merely as a variety of *ratzii*. He also considered *Poteriostomum* a synonym of *Cylicostomum*.

Collected from the floating colon and the large intestine of the native horse.

POTERIOSTOMUM RATZII (Kotlan, 1919).

This species is indistinguishable from the preceding species, except that the elements of the internal leaf crown are all equally large. In *P. imparidentatum* six of the elements of the internal leaf crown are enlarged and longer than the others.

Collected from the large intestine of the native horse.

Genus GYALOCEPHALUS Looss, 1900

GYALOCEPHALUS CAPITATUS Looss, 1900.

Only one or two female specimens were found in the collection. Apparently, this form is found only occasionally in horses in the Philippine Islands, for Schwartz (1925) states, "This parasite was found in only one of the Philippine horses examined, but in that case there were numerous specimens in the cæcum and colon."

Collected from the large intestine of the native horse.

Genus ŒSOPHAGOSTOMUM Molin, 1861

ŒSOPHAGOSTOMUM COLUMBIANUM Curtice, 1890.

Apparently, this is a rather common parasite in goats in the Philippine Islands. Since this form and *Œ. venulosum* inhabit the same hosts, and the two are of about the same size, it is necessary that all specimens be examined microscopically in order to determine the species. An interesting feature noted by the writer while examining several specimens of these two species was that after being killed *columbianum*, with but very few exceptions, remained with the lateral side uppermost as evidenced by the position of the lateral membrane and the cervical papillæ; whereas, *venulosum* remained with either the ventral or dorsal surface uppermost.

This form is easily distinguishable from *venulosum* by the more anterior position of the cervical papillæ (just back of the deep annular constriction of the mouth collar), and by the exterior lateral ray of the bursa of the male which is separated from the mediolateral ray by a wide cleft. It is distinguishable from *dentatum* by having the cephalic vesicle small or absent and the development of lateral cuticular flanges.

Collected from the cæcum of the goat.

ŒSOPHAGOSTOMUM DENTATUM (Rudolphi, 1803).

This form is the smallest of the three species dealt with in this paper.

Relliet and Henry (1913) subdivide the genus *Œsophagostomum* and place this species in the subgenus *Œsophagostomum*.

Collected from the stomach and large intestine of the domesticated pig.

ŒSOPHAGOSTOMUM VENULOSUM (Rudolphi, 1809).

This species was represented in the collection by fewer specimens than *columbianum*.

Collected from the intestine of the goat.

ANCYLOSTOMIDÆ

ANCYLOSTOMINÆ

Genus ANCYLOSTOMA (Dubini, 1843) Creplin, 1845

ANCYLOSTOMA CANINUM (Ercolani, 1859).

A common parasite in the small intestine of dogs in the Philippine Islands.

This form is distinguishable from the following species of the same genus in that there are three pairs of ventral teeth at the oral margin instead of two, and there is a prominence in front of the anus.

ANCYLOSTOMA BRAZILIENSE de Faria, 1910.

This species did not occur in as large numbers in the collection as did *caninum*.

Ancylostoma ceylanicum (Looss, 1911) is a synonym of *A. braziliense*.

Collected from the small intestine of the dog.

NECATORINÆ

Genus BUNOSTOMUM Railliet, 1902

BUNOSTOMUM PHLEBOTOMUM (Railliet, 1900).

The dorsal buccal tooth in this species is short, the length of its dorsal border is less than the distance from its tip to the opening of the mouth; the spicules are from 3.5 to 4 millimeters long, according to Ransom (1911).

Collected from the small intestine of the goat.

BUNOSTOMUM TRIGONOCEPHALUM (Rudolphi, 1808).

This species averages slightly larger in size than the preceding species.

The dorsal buccal tooth is long, the length of the dorsal border is greater than the distance from its tip to the opening of the mouth; the spicules are from 600 to 640 microns long, according to Ransom.

Collected from the small intestine of the goat and sheep.

TRICHOSTRONGYLIDÆ

TRICHOSTRONGYLINÆ

Genus MECISTOCIRRUS (Railliet and Henry, 1912) Neveu-Lemaire, 1914

MECISTOCIRRUS DIGITATUS (von Linstow, 1906).

This is the first record of this parasite from the Philippine Islands. It has been reported from China by Schwartz (1925).

The mouth opening is subterminal and contains a large buccal tooth. The bursa of the male is characteristic, each half containing six rays—two large, one small, and three intermediate in length. The spicules are long and slender and are united for almost their entire length.

Collected from the small intestine of native cattle.

METASTRONGYLIDÆ

METASTRONGYLINÆ

Genus METASTRONGYLUS Molin, 1861

METASTRONGYLUS SALMI Gedoelst, 1923.

This species is closely related to *M. elongatus*. Gedoelst reported this parasite from swine of the Philippine Islands in the year 1923.

Genus DICTYOCAULUS Railliet and Henry, 1907

DICTYOCAULUS VIVIPARUS (Block, 1782).

The mouth is surrounded by four small lips; there is a small buccal capsule about twice as broad as deep; the spicules are equal in length, short and stout, and they have a honeycomb structure.

This parasite occurs in the branchi of cattle.

OXYURIDÆ

OXYURINÆ

Genus OXYURIS Rudolphi, 1803

OXYURIS EQUI (Schrank, 1788).

The anterior portion of the body is curved, and the caudal extremity of the female is elongated and attenuated.

Collected from the floating colon of the horse.

ASCARIDÆ

ASCARINÆ

Genus TOXOCARA Stiles, 1905

TOXOCARA CANIS (Werner, 1782).

The head is slightly curved, and is provided on each side with a membranous wing. The tail just back of the anus is abruptly narrowed.

Collected from the intestine of the dog.

Genus PARASCARIS Yorke and Maplestone, 1926

PARASCARIS EQUORUM Yorke and Maplestone, 1926.

A common intestinal parasite of the horse.

SPIRURIDÆ

SPIRURINÆ

Genus SPIROCERCA Railliet and Henry, 1911

SPIROCERCA SANGUINOLENTA (Rudolphi, 1819).

The mouth is without definite lips and is surrounded by six large dense masses of parenchyma, which are the pulps of the cephalic papillæ. The spicules are unequal.

Collected from the œsophagus (encysted) of a dog.

Genus HABRONEMA Diesing, 1861

HABRONEMA MEGASTOMA (Rudolphi, 1819).

This form is the smallest of the three species of this genus that have been described from the Philippine Islands. According to Schwartz and Cram (1925) the males are from 7 to 10 millimeters in length and the females from 10 to 13 millimeters.

The tail of the male is symmetrical; it is provided with four pairs of preanal papillæ and one pair of postanal papillæ.

Collected from the stomach of the native horse.

HABRONEMA MICROSTOMA (Schneider, 1866).

Ransom records the male as being from 9 to 16 millimeters in length and the female 15 to 25 millimeters.

This species is readily recognized by the vagina of the female in the region of the S-shaped curve being surrounded by a globular mass of muscular tissue. It is recognized also by the asymmetrical arrangement of the postanal papillæ on the tail of the male. Of the four postanal papillæ two are located near the anal opening and two are near the tip.

Collected from the stomach of the native horse.

HABRONEMA MUSCÆ (Carter, 1861).

This species is slightly smaller than *H. microstoma*. The males measure, according to Ransom, from 8 to 14 millimeters in length and the females 13 to 22 millimeters.

The distal portion of the vagina of the female passes transversely half-way or more around the body before it enters the body cavity, and is without a muscular sheath. The tail of the

male is provided with four preanal papillæ (two pairs of these are more nearly adanal) and only three postanal papillæ.

Collected from the stomach of the native horse.

ARDUENNINÆ

Genus ARDUENNA Railliet and Henry, 1911

ARDUENNA STRONGYLINA (Rudolphi, 1819).

Schwartz (1925) says that this species is a common parasite of the hog in the Philippine Islands and is often associated with *Hyostrongylus rubidus*. The latter species was not found in this collection.

This parasite is easily distinguished by the spiral markings in the cylindrical vestibule, and the large asymmetrical caudal alæ which are supported by four pairs of pedunculated preanal papillæ, and one pair of pedunculated postanal papillæ near the tip of the tail.

Collected from the stomach of the domesticated pig.

GNATHOSTOMIDÆ

GNATHOSTOMINÆ

Genus GNATHOSTOMA Owen, 1836

GNATHOSTOMA SPINIGERUM Owen, 1836.

The anterior part of the body is armed with backwardly directed spines, some of which (those just back of the head bulb) are incised into points varying in numbers. The more posterior ones become less subdivided and finally only simple spines are present.

Collected from the stomach of a cat.

BIBLIOGRAPHY

BAYLIS, H. A., and CLAYTON LANE. A revision of the nematode family Gnathostomidæ. Proc. Zöol. Soc. London (1920) 245–310.

BOYNTON, WILLIAM H. Kidney-worm infestation of swine in the Philippine Islands with special reference to the pathological changes. Philip. Journ. Sci. § B 9 (1913) 269–289.

IHLE, J. E. W. Report on the commission appointed to inquire into the sclerostomiasis in Holland. I. Zoölogical Part, I (1922). The adult strongylids (Sclerostomes) inhabiting the large intestine of the horse.

LANE, CLAYTON. The genus Ancyclostoma in India and Ceylon. Indian Journ. Med. Res. I 4 (1916) 74–92.

MORISHITA, KAORU. On a new nematode of the genus Mecistocirrus from cattle in Japan, with remarks on the generic diagnosis. Annot. Zool. Japonenses VIII 10 (1922) 89–99.

RANSOM, B. H. The nematodes parasitic in the alimentary tract of cattle, sheep, and other ruminants. U. S. Dept. Agr. Bur. An. Ind. Bull. 127 (1911).

SCHNEIDER, ANTON. Monographie der Nematoden. Berlin (1866).

SCHWARTZ, BENJAMIN. Helminth parasites of hogs in the Philippine Islands. Philip. Journ. Sci. 27 (1925) 227–233.

SCHWARTZ, BENJAMIN, and E. B. CRAM. Horse parasites collected in the Philippine Islands. Philip. Journ. Sci. 27 (1925) 495–505.

TUBANGUI, MARCOS A. Metazoan parasites of Philippine domesticated animals. Philip. Journ. Sci. 28 (1925) 11–39.

YORKE, W., and P. A. MAPLESTONE. The Nematode Parasites of Vertebrates. P. Blakiston's Son & Co., Philadelphia (1926) xi + 536 pp., 307 figs.

EIN SCHLANGENÄHNLICHER REGENWURM AUS BERGWÄLDERN DER INSEL LUZON

Von W. MICHAELSEN

Hamburg, Germany

EINE TAFEL

Von Herrn W. Schultze, bis vor kurzem Entomologe am Bureau of Science, Manila (jetzt Bad Tölz, Oberbayern), erhielt ich zwei von einem Sammler, Herrn A. Duyag, gefundene, im allgemeinen gut erhaltene Stücke einer *Pheretima*-Art, die sich durch ihre prächtige Färbung und seltsame Zeichnung von allen bekannten Regenwürmern unterscheidet. Bei oberflächlicher Betrachtung mussten die Tiere für Schlangen oder schlangenähnliche Reptilien gehalten werden, und tatsächlich haben nicht nur verschiedene Zoologen, denen ich die noch im Glase zusammengekrümmt liegenden Tiere zeigte, sondern beim ersten Erblicken auch der Sammler geglaubt, eine Reptilienart vor sich zu haben. Ich bezeichne die neue Art deshalb als *Pheretima ophiodes*. Ich spreche Herrn W. Schultze auch an dieser Stelle meinen Dank dafür aus, dass er mir die Bearbeitung dieses interessanten Materials anvertraute.

Fundangabe.—Luzon, Provinz Vizcaya, Berg Alzapan, in ca. 1,300 m. Höhe über dem Meer, an einem trüben, regnerischen Tage, dem 6. Juni 1925, in hohem, dichtem Urwald, wo der Boden mit ganz wenig Unterholz bewachsen, jedoch mit altem Laub bedeckt war. Die Tiere lagen, mit ein paar Blättern teilweise bedeckt, neben der Wurzel eines grossen, alten Baumes, und zwar angeblich mit den Schwanzenden gegen einander und dicht neben einander. Wahrscheinlich hat der Sammler, der die Tiere zunächst nicht genauer betrachten konnte und als Laie auch wohl kaum befähigt war, Kopf- und Schwanzende zu unterscheiden, die Lage der Tiere zu einander verkannt. Ich vermute, dass die beiden Tiere sich in Kopulationslage befanden, die Kopfenden (nicht die Schwanzenden) in entgegengesetzter Richtung eng aneinander geschmiegt.

Beschreibung.—Körpergestalt ziemlich plump, annähernd walzenförmig, in der Region des Gürtels und der männlichen

Pore ventral etwas abgeflacht. Offenbar waren die unberührten Tiere im Leben noch etwas plumper als sie in der Abbildung dargestellt sind, denn der Sammler gibt an, dass sie nach Ausspritzen von Leibeshöhlen-flüssigkeit bei Reizung durch einen Stock an Körperumfang abgenommen haben.

Grössenverhältnisse.—Lebende Tiere nach Angabe des Herrn W. Schultze ungefähr 300 mm lang und mehr als 20 mm dick. Konservierte Tiere 280 bzw. 245 mm lang und 13-15 (am Gürtel 16) bzw. 13-16 (am Gürtel 17) mm dick. Segmentzahl 118 bzw. 106.

Kopfform an den konservierten Tieren nicht mehr deutlich erkennbar, nach der Abbildung anscheinend proepilobisch. Segmente einfach.

Färbung und Zeichnung.—Das charakteristische und seltsame Aussehen der Tiere beruht auf dem Zusammentreffen zweier ganz verschiedener Zeichnungssysteme, einer regelmässig segmentalen Bindenzeichnung und einer von der Segmentierung fast ganz unabhängigen unregelmässigen und unsymmetrischen Fleckenzeichnung. Die regelmässig segmentale Bindenzeichnung wird gebildet von einer am lebenden Tier schillernd dunkelblauen, am konservierten Tier fast schwarzblauen dorsalen Pigmentierung, die ventralwärts im allgemeinen heller, graublau wird und nur an den äussersten Körperenden den ganzen Körperumfang umfasst. Die Bauchseite ist, abgesehen von den Körperenden, bei den konservierten Tieren fast rein weiss. Die Pigmentierung zieht sich an den Randteilen der Segmente viel weiter ventralwärts und lässt hier nur einem ventralmedianen Streifen von einer Breite etwa des $\frac{1}{6}$ Körperumfanges frei. Andererseits zieht sich das pigmentlose Ventralfeld in den Mittelzonen der Segmente in der Form langsam schmäler werdender heller, weisser Binden dorsalwärts etwas über die Seitenmittellinien hinaus. Auf diese Weise entsteht an den Flanken des Wurmkörpers eine regelmässig metamerische Zeichnung von farbigen Intersegmentalbinden und farblosen segmentalen Mittelzonen. Die zu dieser regelmässig segmentalen Zeichnung hinzukommende unregelmässige Zeichnung beruht darauf, dass in verschieden grossen, scharf umrandeten Feldern die dorsale bis dorsallaterale Pigmentierung vollständig ausgelöscht ist, sodass hier fast schneeweisse Felder auftreten. Die Gestalt und Grösse dieser weissen Felder ist sehr verschieden. Die kleineren sind allgemein einfach, in die Breite gezogen, gegen die dorsale Medianlinie breit gerundet, ventralwärts sich ver-

schmälernd und in die weisse Mittelzonen-Binde des betreffenden Segmentes auslaufend, also ganz symmetrisch zur Mittelzone des Segments gestaltet. Es sieht gerade so aus, als wenn eine ätzende Flüssigkeit aus den weissen Mittelzonen-Binden dorsalwärts geflossen sei und, sich hier ausbreitend, das Pigment aufgelöst hätte (Dass ist natürlich nur bildlich aufzufassen). Die kleinsten weissen Flecke erscheinen als nur wenig verbreiterte dorsale Fortsätze der weissen Mittelzonen-Binden und nehmen mit ihrer grössten Breite nur einen Teil der Segmentlänge in Anspruch. Andere Flecke breiten sich bis an die Intersegmentalfurchen ihres Segmentes aus. Noch andere, grössere, überschreiten die Grenzen ihres Segments und dehnen sich auf die angrenzenden Teile der Nachbarsegmente aus. Die Fleckenzeichnung wird aber unregelmässiger, und es entstehen sehr viel grössere Flecken dadurch, dass mehrere, der Anlage nach wohl einfache Flecken mit einander verschmelzen. Bei diesen grösseren, bis 9 Segmente überspannenden Flecken erkennt man die Eutstehung aus dem Zusammenschluss mehrerer Flecken daran, dass mehrere Spitzen zu den weissen Mittelzonen-Binden der Segmente hinführen. Die ganz unregelmässige Gestalt dieser grösseren Flecken erklärt sich daraus, dass die sie zusammensetzenden Einzelflecken vorschieden gross sind und dorsalwärts verschieden hoch aufragen. Im allgemeinen gehen die Flecken dorsalwärts höchstens bis an die dorsale Medianlinie. Manche dieser grösseren Flecken scheinen aber die ganze Breite des Rückens zu überspannen. Dies beruht aber nur darauf, dass hier von jeder Seite her Flecken dorsalwärts aufragen und in der dorsalen Medianlinie aneinanderstossen bzw. hier zu einem Beiderseitflecken verschmelzen. Eine Fleckenbildung geht nur von einem Teil der Segmente aus, und zwar bei den einen nur rechtsseitig, bei anderen nur linksseitig, bei noch anderen beiderseitig. Die Auswahl der Segmente, von denen eine Fleckenbildung ausgeht, scheint ganz gesetzlos zu sein. Auch die Zahl der weissen Flecken ist dementsprechend variabel. Ich zählte bei dem einen, dem abgebildeten Tier, deren 21, bei dem anderen 23 (auch die Kombinationsflecken als Einheit gerechnet). Der Gürtel ist bei beiden Tieren ganz frei von weissen Flecken. Das ist offenbar kein Zufall. Bei dem einen (dem abgebildeten) Tier sieht man deutlich, dass ein grosses, die ganze Breite der Rückenseite von 5. bis 11. Segment überspannendes weisses Feld genau an der vorderen Gürtelgrenze (Intersegmentalfurche $11/12$) in scharfem Absatz endet. Dieses grosse weisse Feld am

Vorderende des abgebildeten Tieres macht den Eindruck einer regelmässigen, symmetrischen Bildung. Tatsächlich haben wir es hier aber nicht mit einer für die Art charakteristischen Zeichnungsform zu tun; denn das andere Tier zeigt vor dem Gürtel 3 kleinere, durchaus unsymmetrisch gestaltete weisse Flecken, von denen keiner an die vordere Gürtelgrenze heranreicht. Auf der hier geschilderten unregelmässigen Fleckenzeichnung beruht hauptsächlich das schlangenähnliche Aussehen der *Pheretima ophiodes*.

Borsten mässig zart, annähernd von gleicher Grösse. Borstenketten ventralmedian ganz geschlossen, dorsal ungemein weit unterbrochen (annähernd $ZZ = \frac{1}{4}\ U$), ventral sehr dicht, an den Flanken des Tieres dorsalwärts viel weitläufiger werdend. Borstenzahlen: 60/VII, 67/XX, 72/XXX.

Rückenporen von Intersegmentalfurche 12/13 an vorhanden, im allgemeinen recht deutlich, besonders deutlich in der vorderen Gürtelregion. Diese vordersten Rückenporen erscheinen als dunkle Löcher am Grunde verhältnismässig grosser, längsovaler trichterförmiger Einsenkungen in der hier besonders dicken Gürtelhypodermis.

Gürtel in einer für die Gattung *Pheretima* ganz ungewöhnlichen Erstreckung, am 12. bis 17. Segment (= 6), dorsalmedian vielleicht sogar noch einen kleinen dreiseitigen Vorstoss auf das 11. Segment hinaufmachend (Hier zeigt sich bei dem abgebildeten Tier ein kleiner Pigmentvorstoss in dass grosse pigmentlose Feld, das vermutlich durch den Gürtel begrenzt wird (siehe oben!). Der Gürtel ist ringförmig, aber ventral etwas schwächer ausgebildet. Er zeichnet sich nicht nur durch eine Verdickung der Hypodermis aus, sondern an den konservierten Tieren auch durch eine Verschleierung des im allgemeinen leuchtend blauen Pigments bzw. der rein weissen Ventralfärbung, wie wenn ein zarter bräunlicher Anflug darüber gelegt sei. Am lebenden Tier ist nach Massgabe der Abbildung von einer solchen Verschleierung nichts zu erkennen; an diesen ist der Gürtel infolgedessen nicht so scharf ausgeprägt. Die Intersegmentalfurchen, Borsten und Rückenporen sind am Gürtel nich weniger deutlich als an den übrigen Körperregionen, die Rückenporen sogar zum Teil beträchtlich deutlicher.

Männliches Geschlechtsfeld: Die männlichen Poren liegen ventrallateral in der Borstenzone des 18. Segments, ungefähr 1/3 des Körperumfanges voneinander entfernt, auf der medialen Kuppe quer-ovaler, stark erhabener Porophoren, deren lateraler Pol sich in einen dicklichen Wall fortsetzt. Dieser Wall biegt

sich sofort hakenförmig nach hinten und medialwärts um und verläuft in der Vorderzone des 19. Segments eine kurze Strecke bis etwas medial über die Linie des männlichen Porus hinaus, um sich hier abzuflachen und zu verlieren. Der etwas vertiefte Winkelraum auf Intersegmentalfurche 18/19 zwischen dem männlichen Porophor und diesem Wall, seinem Ausläufer, hat ein dunkles, drüsiges Aussehen. Auch die intersegmentalfurche 17/18 hat vor den männlichen Porophoren ein solch drüsiges Aussehen, wenn auch nicht ebenso deutlich. Sehr deutliche längliche Drüsenfelder von gleichen Aussehen liegen dagegen auf Intersegmentalfurche 19/20, ein sehr Geringes medialwärts verschoben. Auch diese sind vorn und hinten von je einem Wall begleitet, und die beiden Wälle einer Seite fliessen lateral vom Drüsenfeldchen, das sie hier einfassen, zusammen. Auch mit den oben erwähnten Wällen am 19. Segment sind sie lateral verschmolzen.

Weibliche Poren paarig, zwei winzige nadelstichige Löcher etwas vor der Borstenzone des 14. Segments, dicht neben der ventralen Medianlinie, umgeben von einem gemeinsamen, querovalen, etwas dunkleren, schwach eingesenkten ventralmedianen Hof.

Samentaschenporen 3 Paar, ventrallateral auf Intersegmentalfurche 4/5, 5/6 und 6/7, die eines Paares ungefähr 1/3 des Körperumfanges von einander entfernt. Sie sind durch ziemlich grosse, dunklere, graublaue Drüsenhofe mit verwaschenem Umriss augenscheinlich gemacht.

Dissepimente sämtlich zart, keines in der Magenregion fehlend.

Darm.—Ein grosser tonnenförmiger Muskelmagen im 8. Segment. Ich konnte am zarten, infolge starker Erweichung sehr hinfällig gewordenen Mitteldarm keine typischen *Pheretima*-Blindsäcke erkennen; doch sah ich in der Region, in der sie sonst auftreten, etwa im 26. bis 38. Segment an der Rückenseite des Mitteldarms jederseits 2 oder 3 zarthäutige Säckchen, die in jedem dieser Segmente von der hinteren Partie des Darmes, wenn nicht von den hier verlaufenden Blutgefässen nach vorn in die Leibeshöhle hineinhingen. Ich glaube es hier mit Lymphdrüsen zu tun zu haben.

Letzte Herzen im 13. Segment.

Exkretionssystem: Nur Mikronephridien gesehen.

Vordere männliche Geschlechtsorgane: 2 Paar Samentrichter ventral im 10. und 11. Segment. Es liess sich bei der weit vorgeschrittenen Erweichung der inneren Organe nicht fest-

stellen, ob die Sammentrichter in Testikelblasen eingeschlossen waren. 2 Paar verhältnismässig dünne, längliche, einfache *Samensäcke* im 11 und 12. Segment, in ganzer Länge an die Hinterseite der Dissepimente 10/11 und 11/12 angeheftet.

Hintere männliche Geschlechtsorgane: Die Prostaten sind ganz auf das 18. Segment beschränkt. Drüsenteil dick schildförmig, etwas länger als breit, scharfkantig, fast kompakt, mit sehr spärlichen Einkerbungen am Rande, flach an die Innenseite der Leibeswand angelegt. Ausführgang kurz, mässig und gleichmässig dick, gerade gestreckt, quer verlaufend, an der Unterseite des Drüsenteils entspringend, "in situ" ganz unter dem Drüsenteil verborgen, unmittelbar ausmündend. Kopulationstaschen sind nicht vorhanden.

Samentaschen sehr verschieden gross, die des hinteren Paares am grössten, die des vorderen Paares am kleinsten. Haupttaschen einfach sackförmig oder birnförmig, zartwandig, anscheinend ohne besonderen Ausführgang; ein etwaiger besonderer Ausführgang könnte nur kurz und eng, ganz in der Leibeswand verborgen sein. Die Haupttaschen sind bei dem näher untersuchten Stück ganz leer und kollabiert. An den meisten dieser Haupttaschen war keine Spur eines Divertikels zu erkennen; an der mittleren und vordersten Samentasche der rechten Seite fand sich jedoch dicht vor dem ektalen Ende je eine kleine kugelige Blase, dünnhäutig und mit undurchsichtig weisslichem Inhalt, anscheinend ohne Stiel am ektalen Ende der Haupttasche sitzend, zweifellos ein kleines Divertikel. Ich vermute, dass ein solches Divertikel erst bei Füllung mit Spermienmassen deutlich sichtbar wird, und dass es an den übrigen Samentaschen leer und wie die Haupttasche kollabiert war, dass es also nur wegen seiner Zartheit in ungefülltem Zustande übersehen worden ist.

Erörterung: Pheretima ophiodes unterscheidet sich von allen Gattungsgenossen nicht nur durch seine absonderliche Zeichnung, sondern vor allem durch die Erstreckung des Gürtels. Die Regel ist für *Pheretima* ein ringförmiger Gürtel, der sich über die 3 Segmente vom 14. bis zum 16. (einschliesslich) erstreckt. Zuweilen bleib der Vorderrand des 14. Segments oder der Hinterrand des 17. Segments, wenn nicht beide zugleich, gürtelfrei. Eine weitere Erstreckung des Gürtels über Teile des 13. und 17. Segments ist eine seltene Erscheinung. Eine Erstreckung nach vorn hin bis über das 12. Segment ist bisher bei *Pheretima* nich beobachtet worden. Am nächsten kommen unserer neuen Art

nach *Ph. beccarii* Cogn. [Gürtel am 13. bis ½ 17. Segment (= 4½)] und *Ph. zonata* Mich. [Gürtel am ½ 13. bis ½ 18. Segment (= 5)], beide von Borneo.

Pheretima ophiodes steht offenbar den beiden Arten *Ph. iris* (Mich.) und *Ph. margaritacea* (Mich.),[1] ebenfalls von den Philippinen (Insel Samar), nahe, die beide die erste Stufe einer weiteren Erstreckung des *Gürtels* über die Intersegmentalfurche 13/14 und 16/17 hinaus aufweisen. Sie gleichen der neuen Art besonders auch in dem ungewöhnlichen Charakter der *Samentaschen,* deren Ampulle keinen besonderen muskulösen Ausführgang erkennen lässt, ebensowenig wie das kleine, einfache, sitzende Divertikel. Auch die Gestaltung der *Prostaten* ist bei allen drei Arten die gleiche. Leider war die innere Organisation der beiden älteren Arten des schlechten Erhaltungszustandes wegen nur sehr lückenhaft klar zu stellen; vor allem ist die Bildung der Dissepimente in der Ösophagus-Region, die des *Darmes* und der *vorderen männlichen* Geschlechtsorgane unbekannt. Bemerkenswert ist vielleicht noch, dass auch jene beiden älteren Philippinen-Arten eine (durch die schlechte Konservierung stark verblichene?) bläuliche *Färbung,* in der Gattung *Pheretima* sonst nie beobachtet, aufweisen. *Ph. ophiodes* unterscheidet sich übrigens von jenen beiden älteren Arten sofort durch die *Lage der Begattungsporen,* die bei den beiden Arten von der Insel Samar *der ventralen Medianlinie sehr* nahe gerückt sind; während sie bei *Ph. ophiodes* eine Spannweite von ungefähr 1/3 des Körperumfanges besitzen.

Zur Biologie der *Ph. ophiodes* ist Folgendes hauptsächlich nach den Angaben des Sammlers zu bemerken: Als der Sammler (im Glauben, eine Schlange vor sich zu haben) mit seinem Stock nach dem vermeintlichen Giftreptil schlug (glücklicherweise ohne einen der beiden Würmer erheblich zu verletzen), spritzte das leicht getroffene Tier im selben Augenblick in vielen feinen Strahlen [aus den wohl ausgebildeten Rückenporen] eine Flüssigkeit bis zu einer Höhe von mindestens 1½ m aus. Hierbei wurde der Leibesumfang des Tieres sichtlich geringer, so, wie in der Abbildung angegeben. Auch das zweite Tier spritzte bei der ersten Berührung mit dem Stock feine Strahlen bis zu jener Höhe aus; bei der zweiten, dritten und vierten Berührung gingen die Strahlen weniger hoch, zuletzt nur noch bis 2 oder 3 cm.

[1] *Megascolex iris* und *M. margaritaceus* W. Michaelsen, 1892, Terricolen der Berliner Zoologischen Sammlung. II. In: Arch. V 58, I, 4. Naturgesch., p. 244. Taf. 13, Fig. 24; p. 245, Taf. 13, Fig. 25.

Einige den Sammler begleitende Träger (Negritos, die in diesen Bergen von Luzon hausen) behaupteten, dass die von den Würmern ausgespritzte Flüssigkeit ätzend sei und besonders gefährlich wäre, wenn sie in die Augen käme. Wie dem auch sei, jedenfalls dürfen wir wohl annehmen, dass das Ausspritzen der Leibeshöhlenflüssigkeit aus den Rückenporen als Schreckmittel diene.

Die eingeborenen Träger sagten des weiteren aus, dass es eine Schlange gäbe, die ebenso aussähe wie diese Würmer. Hierzu schreibt mir Herr W. Schultze: Diese letzte Angabe muss mit Vorsicht aufgenommen werden, da ich selbst nahezu alle von Luzon bekannten Schlangenarten kenne, und darunter keine ist, die den Würmern ähnlich sieht. Die Farbe und Zeichnung der Würmer ist ohne Zweifel eine Schutzfärbung, die etwas schlangenartiges an sich hat. Sollte es jedoch an demselben Orte eine Schlangenart mit dem Aussehen der Würmer geben, so wäre das ein weiterer sehr bemerkenswerter Beitrag zu-den Mimikry-Formen der Philippinen. Wir dürfen wohl jedenfalls annehmen, dass wir es hier mit einer Schreck-oder Warnzeichnung zu tun haben, sei es, dass sie als Nachahmung einer Giftschlange etwaige Verfolger zurückschreckt, als Warnung vor etwaigen üblen Folgen des Ausspritzens der Leibeshöhlenflüssigkeit dient oder ledliglich die Ungeniessbarkeit des Wurms anzeigt.

TAFELERKLÄRUNG

TAFEL 1

FIG. 1. *Pheretima ophiodes* sp. nov., von der Rückenseite gesehen, in natürlicher Grösse.

2. Das Vorderende desselben Tieres von der Bauchseite gesehen.

3. Ein Stück des Hinterkörpers von der linken Seite gesehen.

TAFEL 1.

A CHÆTODONT NEW TO THE PHILIPPINES

By HERACLIO R. MONTALBAN

Of the Division of Fisheries, Bureau of Science, Manila

ONE PLATE

HOLACANTHUS BISPINOSUS Günther.

Holacanthus bispinosus GÜNTHER, Cat. Fishes 2 (1860) 48, 516; Fische der Südsee 1 (1873) 51, pl. 56, fig. C; BLEEKER, Verh. Akad. Amsterdam 17 (1877) 125; Atlas Ichthy. 9 (1878) 60, pl. 368, fig. 1; JORDAN and EVERMANN, Bull. U. S. Fish Comm. 23 (1903) (1905) 378, pl. 56; JORDAN and SEALE, Bull. Bur. Fisheries 25 (1905) (1906) 348; WEBER, Fische Siboga Exp. (1913) 311.

Holacanthus diacanthus BLEEKER, Act Soc. Sc. Indo-Neerl. 2 (1857) 57 (not Boddaert, Günther).

Dorsal XIV, 17 or 18; anal II, 19 or 20; scales in lateral series 48, between lateral line and origin of dorsal 6, and between lateral line and origin of anal 19 or 20.

Body elliptical and compressed, depth 1.8 in the length, ventral outline more evenly but somewhat less deeply arched than the dorsal; head shorter than deep, 3.7 to 3.8 in length of body, upper profile deeper than the lower; caudal peduncle short, least depth about twice in head; interorbital space moderately and evenly convex, least width 2.6 to 2.7 in head; snout short and bluntly rounded, as long as eye's diameter which is 2.8 to 2.9 in head; maxillary 3 to 3.1 and widest portion of preorbital 4.3 to 4.4 in head; mouth small, upper jaw slightly projecting and maxillary slipping under the coarse serrated preorbital; nostrils small, close together in front of eye, the anterior one having a marginal flap which is highest behind and the other with a slightly curved, stout spine which is preceded by a much shorter one; preopercle with a series of small sharp spines at vertical edge; subopercle with three or four closely set small and sharp spines; both opercle and interopercle unarmed.

Scales below lateral line larger than those anywhere on the rest of the body; scales on the head and fins numerous, and very small to minute; dorsal spines evenly graduated to the last, which is the highest and 1.3 to 11.4 in head; third anal spine about as high as last dorsal; both rayed dorsal and anal angular and equal

in height; pectoral longer than head; caudal convex, about as long as pectoral; ventral fin with spine 1.4 to 1.6 in head, and first ray filamentous and extending to base of anal spines.

Ground color in life deep cherry red traversed on side by about eighteen broken brownish-black bars as wide as the interspaces; head brownish black; the vertical fins brownish black, narrowly edged with blue-white and marked with a longitudinal series of black spots; caudal fin brownish black, with a blue-white edge behind and a vertical series of black spots; pectoral bright yellowish orange, with a blackish blotch at the base; ventral yellowish orange, its spine and first three rays slightly washed with blackish; lips and preopercular and subopercular spines brownish black; breast and belly deep cherry red.

The ground color in alcohol yellowish white, with the color of the cross-bars, head, vertical fins, and caudal remaining unchanged; the rayed dorsal, anal, and caudal fin obscurely spotted with black and narrowly tipped with dull blue-white; pectoral yellowish white, with a brownish blotch at its base; ventral similarly colored, with its spine and first three rays slightly brownish.

The above description is taken from two specimens, 78.5 and 81 millimeters in length, from Lumbian Islands, Sulu Archipelago. This is the first Philippine record of this species, which is known to occur in Zanzibar, Amboina, New Hebrides, Tahiti, Samoa, and the Hawaiian Islands. It bears some resemblance to *Holacanthus multispinis* Playfair, but is distinguished at once from the latter by the absence of the shoulder blotch.

ILLUSTRATION

PLATE 1. *Holacanthus bispinosus* Günther, enlarged. (Drawing by Antonio Canlas.)

PLATE 1. HOLACANTHUS BISPINOSUS GÜNTHER.

NEW OR LITTLE-KNOWN TIPULIDÆ FROM THE PHILIPPINES (DIPTERA), VI[1]

By CHARLES P. ALEXANDER

Of Amherst, Massachusetts

THREE PLATES

The interesting series of crane flies discussed at this time was taken at and above Ube, Laguna Province, Luzon, in 1929, by my friend Mr. Richard C. McGregor and his coworkers, Messrs. Celestino, Duyag, and Rivera.[2] The majority of these specimens were taken between altitudes of 400 and 800 meters. Two species were taken on Tablas Island, Romblon Province, by Messrs. Rivera and Duyag, and one is recorded from Samar. I am vastly indebted to the collectors for the privilege of retaining the types of the novelties described at this time.

TIPULINÆ

NESOPEZA OBERON sp. nov.

General coloration pale yellow, the mesonotum and pleura with a conspicuous brownish black pattern; tips of femora and tibiæ blackened; wings narrow, grayish subhyaline, with a heavy dark brown costal pattern; forks of medial field shallow; cell 2d A narrow; male hypopygium with the lateral angles of the sternite produced into dusky lobes.

Male.—Length, about 6 millimeters; wing, 7.

Female.—Length, about 8.5 millimeters; wing, 7.

Rostrum and palpi black. Antennæ with the scape and basal segment of flagellum ocherous, the remainder of the flagellum passing into black. Front yellow, with a median brown triangle.

Pronotum pale yellow, narrowly dark brown medially. Mesonotal præscutum pale yellow with three very conspicuous brownish black stripes; scutum similarly pale, each lobe with two confluent brownish black areas; scutellum black; postnotal me-

[1] Contribution from the Department of Entomology, Massachusetts Agricultural College.

[2] Ube is the official spelling of the name of the barrio near which most of these crane flies were collected.

diotergite brownish black medially, paling to obscure yellow on sides. Pleura with the ground color yellow, striped and spotted with brownish black, the latter color including the anepisternum, dorsal pleurotergite, and a ventral stripe occupying the ventral sternopleurite and meral region; the pale ground color thus includes the dorsopleural membrane, dorsal sternopleurite, pteropleurite, and a conspicuous area on the ventral pleurotergite. Halteres elongated, pale yellow, the knobs dark brown. Legs with the fore coxæ brownish black, the remaining coxæ and all trochanters pale yellow; femora obscure yellow, the tips narrowly brownish black, preceded by a very narrow, clearer white, subterminal ring; remainder of legs yellowish white, the tips of the tibiæ very narrowly but conspicuously blackened. Wings (fig. 1) relatively narrow, grayish subhyaline, with a dark brown costal pattern, as in the typical subgroup of the genus; a narrow brown seam on the cord and at the end of vein 1st A; dark areas bordered by a narrow more-hyaline line, this not so evident as in *N. geniculata;* veins brownish black. Venation: Medial forks very short; cell 2d A narrow.

Abdominal tergites brownish black, with a series of yellow spots on the dorsomedian region shortly before the caudal margin; sternites less conspicuously but more extensively variegated with yellow on the subterminal segments. Male hypopygium having the caudal margin of the tergite with three rounded lobes, the median one smaller. Lateral angles of the sternite produced into dusky lobes that are tipped with conspicuous yellow setæ.

LUZON, Laguna Province, above Ube, Mount Banahao, altitude 500 meters, May 27, 1929 (*McGregor*); holotype, male; allotype, female.

Nesopeza oberon is allied to *N. costalis* (Brunetti) of South India and *N. geniculata* Alexander of Japan, differing conspicuously in the brownish black thoracic pattern.

Genus SCAMBONEURA Osten Sacken

Scamboneura OSTEN SACKEN, Berlin. Entomol. Zeitschr. 26, Heft 1 (1882) 95.

Including the two new species described at this time there are now eight species of this most interesting genus known from the Philippines. I am taking this opportunity of describing and figuring the male hypopygium of the genotype, *dotata* Osten Sacken, and of *psarophanes* Alexander.

The essential features of the male hypopygium in the genus are as follows: Usually small, in some species more enlarged; tergite distinct from basistyle, the latter in part fused with the sternite, separated therefrom by a ventral suture that is upcurved at its cephalic end. Ninth tergite more or less trilobed. Outer dististyle a broad pale lobe. Inner dististyle blackened, jutting into the notch of the tergite, provided with retrorse setæ to produce a more or less hystriciform appearance. Ninth sternite deeply incised, at the base of the notch bearing a median depressed plate or lobe, this structure offering excellent characters for the separation of the different species.

SCAMBONEURA DOTATA Osten Sacken.

Scamboneura dotata OSTEN SACKEN, Berlin. Entomol. Zeitschr. 26, Heft 1 (1882) 95.

Rather numerous specimens have been taken at and above Ube, March 22 to 28 and May 1 to 4, 1929 (*McGregor and Duyag*).

The male hypopygium (fig. 19) has the ninth tergite (fig. 20) with the caudal margin produced into a lateral blackened ledge, separated from two small slender fingerlike lobes by a rounded incision; mesal margin of the submedian lobes with a few setæ; margin of the blackened ledges microscopically serrulate. Basistyle, *b*, relatively long and narrow. Outer dististyle (fig. 21) flattened, expanded distally, the outer cephalic angle further produced into a dusky fingerlike lobule. Inner dististyle, *id*, short and massive, shaped as in the figure, the mesal surface with long white setæ. Median appendage of ninth sternite (fig. 22) appearing as a subcircular flattened structure bearing very small lateral lobes on either side.

SCAMBONEURA PSAROPHANES Alexander.

Scamboneura psarophanes ALEXANDER, Philip. Journ. Sci. 33 (1927) 294–295.

Ube, March 25 to 28, 1929 (*Duyag*); June 1, 1928, resting on upper side of leaf in light forest (*McGregor*); above Ube, altitude 800 meters, May 18, 1929 (*McGregor*).

Male hypopygium somewhat as in *S. dotata* but differing in all details. Ninth tergite (fig. 23) not or but weakly chitinized, unblackened; lateral lobes pale, much larger than the simple median lobule; caudal margin of tergite and margin of ridges on ventral surface with small blackened points. Outer dististyle (fig. 24) broad, pale, the apex narrowed to a simple obtuse

point. Inner dististyle (fig. 25) relatively slender, blackened, provided with long pale retrorse setæ. Appendage of ninth sternite (fig. 26) a flattened depressed blade bearing small but conspicuous lateral shoulders, the apex evenly rounded and fringed with short setæ; lateral margins of basal portion of plate somewhat more thickened.

SCAMBONEURA UNICOLOR Bezzi.

Scamboneura dotata unicolor BEZZI, Philip. Journ. Sci. § D 12 (1917) 112.

Majayjay, May 3, 1928 (*McGregor*); a female, above Ube, altitude 500 meters, May 20, 1929, resting on *Pandanus* leaf (*McGregor*).

SCAMBONEURA VITTIVERTEX sp. nov.

General coloration yellow, the præscutum with slightly indicated more reddish stripes; antennal flagellum black; head orange, with a capillary black vitta on posterior vertex; pleura pale yellow; male hypopygium with the sternal appendage an elongate flattened plate, widest at near two-thirds its length, the apex weakly notched.

Male.—Length, about 12 millimeters; wing, 11 to 11.5.

Female.—Length, about 16 millimeters; wing, 13.5.

Frontal prolongation of head yellow, the slender nasus black; palpi obscure yellow, the outer segments brownish black. Antennæ with the scape yellow; flagellum black; antennæ (male) elongate, the verticils short. Head deep orange; occipital band brownish pruinose, sending a narrow black median vitta cephalad almost to the summit of the vertical tubercle; genæ slightly pruinose.

Mesonotum obscure yellow, the præscutum with three slightly darker reddish stripes; in cases, the median stripe is again split by a capillary darker vitta; humeral region narrowly darkened; scutal lobes yellow, each with two confluent brown areas; disk of scutellum darkened; center of postnotal mediotergite infuscated. Pleura pale yellow, the dorsopleural membrane more opaque. Halteres dark brown, the extreme base of stem brightened. Legs with the coxæ yellow, the cephalic face of the fore coxæ darkened; trochanters yellow; femora yellowish brown; remainder of legs deepening through dark brown to black. Wings subhyaline, the small stigma and cells Sc and Cu_1 darker; veins black, the macrotrichia long and conspicuous. Venation: Forks of medial cells deep; anterior cord strongly bowed.

Abdominal tergites yellow, trivittate with brownish black, the median stripe broadest, interrupted at the caudal margins of the tergites; subterminal segments more uniformly pale, especially in the female; eighth tergite (male) blackened; hypopygium reddish brown; basal sternites clear yellow, the outer segments more orange. Male hypopygium (fig. 27) relatively small. Ninth tergite (fig. 28) not heavily chitinized on any portion; lateral lobes flattened, their margins obtuse; submedian portion of the caudal lobes with a dense fringe of short black setæ. Outer dististyle (fig. 29) broadly ear-shaped, not produced into a point. Inner dististyle (fig. 30) with the apical blackened beak very slender; disk of the style with conspicuous retrorse setæ. Appendage of the ninth sternite (fig. 31) a conspicuous flattened plate, more chitinized at extreme base, followed by a constriction, beyond which the plate gradually widens, reaching its widest point at near two-thirds the length; apex of plate weakly notched; the broad flaring margins are thinner and more nearly transparent than the median infuscated portion.

LUZON, Laguna Province, above Ube, Mount Banahao; holotype, male, March 30, 1929 (*McGregor*); allotype, female, March 29, 1929 (*McGregor*); paratypes, a broken specimen, tangled in spider's web, March 24, 1929 (*McGregor*); 1 female, March 25, 1929 (*Duyag*); several males and females, March 29 to 31 to June, 1929 (*McGregor and Duyag*); both sexes, above Majayjay, altitude over 500 meters, in light forest, one resting on a leaf, June 1, 1928 (*McGregor*).

Scamboneura vittivertex is readily told from *S. unicolor* Bezzi, which it superficially resembles, by the conspicuous black vitta on the vertex.

SCAMBONEURA HIRTISTERNATA sp. nov.

Mesonotal præscutum yellow with three nearly opaque brown stripes; antennæ (male) with the flagellum black, of the female bicolorous; head orange, the occipital brand gray, sending a narrow black line cephalad to the vertical tubercle; abdominal tergites yellow, broadly margined laterally with brownish black, the posterior ring of each segment with a blue-black area; male hypopygium large, tumid, reddish; eighth sternite with conspicuous brushes of long reddish setæ on either side of a median emargination.

Male.—Length, about 11 millimeters; wing, 9.5.

Female.—Length, about 14 millimeters; wing, 11.3.

Frontal prolongation of head yellow, darker dorsomedially; nasus brownish black; palpi pale brown, the terminal segment passing into black. Antennæ (male) of moderate length; basal segment dark beneath, the remainder yellow; second segment yellow; flagellum entirely black. Antennæ (female) distinctly bicolorous, the basal flagellar segment black at base, the apex yellow; on flagellar segments 1 and 2 the amount of yellow includes about one-third the length of the segment; the amount of yellow gradually lessens on the outer segments, the more distal being entirely black. Head orange, the orbits narrowly silvery; posterior vertex and genæ more pruinose; a conspicuous gray rectangular brand on the occiput and posterior vertex, this sending a narrow velvety black median line cephalad onto the vertical tubercle.

Pronotum pale yellow, more infuscated in front. Mesonotal præscutum yellow, with three nearly opaque brown stripes, the anterolateral ends of the lateral stripes narrowly blackened; humeral region infuscated; scutum yellow, the lobes grayish brown, the mesal edge of each lobe velvety black; scutellum chiefly infuscated, obscure yellow at base; postnotal mediotergite yellow with a broad gray median longitudinal stripe that widens slightly behind, the caudal margin with two approximated dark brown spots. Pleura pale yellow, vaguely marked with grayish brown on the anepisternum and pleurotergite. Halteres obscure yellow, the knobs dark brown. Legs with the coxæ pale, the anterior face of the fore coxæ restrictedly pruinose; trochanters pale yellow; femora yellowish brown, the tips narrowly darkened; tibiæ dark brown; tarsi brownish black. Wings whitish, the small stigma and cells Sc and Cu_1 more infumed; veins black, those in the costal region more brownish. Macrotrichia of veins of male long and conspicuous, black; of female shorter and less conspicuous. Venation: Rs very short, delimiting the proximal end of the stigma; anterior cord greatly bowed, as usual in the genus; petioles of medial cells short, the forks correspondingly deep and narrow; m-cu about one-half its length beyond the fork of M.

Abdominal tergites yellow, broadly margined laterally with brownish black; a conspicuous blue-black area on each tergite, occupying the posterior ring of the segment, this narrowly bordered by brown, most evidently so at caudal end; sternites pale yellow; hypopygium chiefly reddish brown, large and tumid. Male hypopygium (fig. 32) with the ninth tergite (fig. 33) tumid,

the caudal margin feebly notched. Basistyle entire, extending back to the eighth tergite. Outer dististyle pale, flattened, roughly triangular in outline, the apex slightly pointed. Appendage of ninth sternite a conspicuous reddish two-pronged structure. Eighth sternite large, the caudal edge emarginate and membranous, on either side of the notch with a brush of long reddish setæ.

TABLAS, Romblon Province, Badajoz, August 25, 1928 (*Francisco Rivera and A. C. Duyag*), holotype, male; allotype, female, August 26, 1928.

Scamboneura hirtisternata is peculiar in the uniformly blackened flagellum of the male sex and the distinctly bicolored organ of the female. I can see no reason for considering these specimens as being distinct species. By my key to the Philippine members of the genus[3] the female sex runs to *S. dotata* Osten Sacken, differing in the coloration of the thorax; the male runs to *S. faceta* Alexander, differing in the coloration of the body and the very different male hypopygium.

TIPULA FUSCOANGUSTATA sp. nov.

General coloration orange; antennal flagellum weakly bicolorous; wings gray, the costal margin narrowly dark brown.

Female.—Length, about 19 millimeters; wing, 15.5.

Frontal prolongation of head yellow, the nasus conspicuous; mouth parts and palpi yellow. Antennæ with the scape yellow; flagellum weakly bicolorous, the bases of the segments broadly dark brown, the narrow tips vaguely paler. Head olive-green, the frons and occiput restrictedly more yellow; no evident vertical tubercle.

Mesonotal præscutum orange brown, with three clearer yellow stripes that are only vaguely evident against the ground color; remainder of mesonotum orange, the scutal lobes with more yellowish areas. Pleura clear yellow, the dorsopleural region more orange. Halteres dark brown, restrictedly yellow at base of stem. Legs with the coxæ and trochanters yellow; femora brownish yellow, the tips infuscated; remainder of legs black; tarsi very long and slender, only a little shorter than the combined femora and tibiæ. Wings (fig. 2) highly iridescent; ground color gray, the costal margin narrowly dark brown, including cells C, Sc, stigma, and a narrow costal seam in the radial field to the wing tip; a conspicuous seam on anterior cord;

[3] Philip. Journ. Sci. 33 (1927) 293–294.

less distinct clouds at origin of Rs and marginal at tips of Cu_1; prearcular region suffused; veins black. Venation: R_{2+3} long, about one-third longer than R_{1+2}; cell R_2 small; petiole of cell M_1 subequal to m; cell 2d A narrow.

Basal abdominal tergites yellow, passing through brown to black, the subterminal segments very narrowly margined with yellow; basal sternites bright yellow, the subterminal segments blackened; genital segment yellow; valves of ovipositor dark chestnut, the valves paler at tips.

LUZON, Laguna Province, above Ube, Mount Banahao, March 29, 1929 (*McGregor*).

The diagnostic features outlined above suffice to make the present species readily recognizable. It is apparently a member of the subgenus *Acutipula*, but I cannot be certain of this with only the female sex available.

LIMONIINÆ

LIMONIA (LIBNOTES) ILLECEBROSA sp. nov.

General coloration pale yellow; mesonotal præscutum with a $\wedge$-shaped dark marking; legs yellow, the tips of the femora narrowly darkened; wings yellow with a restricted dark pattern; R_{1+2} long-produced beyond R_2; cells 2d M_2 and M_3 subequal in length.

Male.—Length, about 11 millimeters; wing, 13.6.

Female.—Length, about 9.5 millimeters; wing, 12.

Rostrum nearly as long as the remainder of the head, dark brown; palpi paler brown. Antennal scape dark brown, the second segment paler; flagellum pale brownish yellow, the segments with unilaterally arranged verticils of moderate length. Head light brown, variegated with darker; eyes virtually contiguous above (male) or slightly more separated (female).

Pronotum pale yellow, crossbanded with dark brown. Mesonotal præscutum greenish yellow, with a $\wedge$-shaped saddle, the lateral ends consisting of the anterior portions of the lateral stripes darker brown, the median point, consisting of the usual median stripe, paler brown; remainder of the notum pale yellow, the lateral ends of the suture, the centers of the scutal lobes, and the posterior-lateral portions of the postnotal mediotergite dark brown. Pleura pale yellow. Halteres pale, the knobs dark brown. Legs with the coxæ and trochanters pale yellow; femora yellow, the tips narrowly dark brown; tibiæ and tarsi yellow, the latter passing into brown at tips. Wings (fig. 3)

iridescent, with a pale yellow ground color, the prearcular and costal regions clearer yellow; a restricted brown pattern, as follows: Extreme base of wing; a postarcular band completely traversing the wing; a narrow band at the cord, completely traversing the wing except on the distal section of Cu_1; tip of Sc; outer end of cell 1st M_2; stigmal area and adjoining veins; tips of veins R_3 and R_{4+5}; veins pale yellow, blackened in the infuscated areas. Venation: $R_{1+2} + Sc_2$ produced beyond the level of R_2; R_{1+2} extended as a spur beyond the free tip of Sc_2; cells 2d M_2 and M_3 equal in length; cell 2d A small.

Abdomen yellow, the tergites marked laterally before the caudal margins with brownish black triangles, on the third segment forming a narrow complete ring. Male hypopygium (fig. 34) with the ninth tergite, *9t*, relatively large, the caudal margin nearly transverse. Dorsal dististyle slender, sinuous. Ventral dististyle, *vd*, with the rostral prolongation elongate, with three long spines at base; face of style produced into a pale lobe bearing three additional spinous setæ. Margin of gonapophysis, *g*, weakly serrulate.

LUZON, Laguna Province, Ube, Mount Banahao, March 28, 1929 (*A. C. Duyag*), holotype, male; March 31, 1929 (*McGregor*), allotype, female.

By Edwards's key to the species of *Libnotes*, the present species runs to couplet 28, differing markedly from *quadrifurca* (Walker) in the diagnostic features listed above. It should be reaffirmed that the peculiar structure of the ventral dististyle is found not only in a number of diverse-appearing species of *Libnotes* but also in species of the typical subgenus of *Limonia*.

LIMONIA (LIBNOTES) NOTATA (van der Wulp).

Libnotes notata VAN DER WULP, Tijdschr. v. Ent. 21 (1878) 194, pl. 12, fig. 5.

One male, above Ube, Laguna Province, Luzon, March 30, 1929 (*McGregor*). The venation is shown in Plate 1, fig. 4.

LIMONIA (LIBNOTES) RIVERAI Alexander.

Limonia (*Libnotes*) *riverai* ALEXANDER, Philip. Journ. Sci. 40 (1929) 255.

This species was described from the female sex. Three additional males and one female are now available, taken at Ube, March 24, 1929, by McGregor. One of the former is herewith described as allotype.

Characters nearly as in the female. Costal fringe of wings very long and conspicuous. Venation: Sc_1 ending opposite or just before the fork of Rs. Male hypopygium (fig. 35) with the basistyle, *b*, relatively slender, the ventromesal lobe low, occupying almost the whole face of the style. Dorsal dististyle lacking. Ventral dististyle, *d*, an oval lobe that narrows gradually into the rostral beak. Mesal-apical lobe of gonapophysis, *g*, long and straight. Ædeagus, *a*, long and slender.

Male.—Length, about 6.2 millimeters; wing, 7.

LUZON, Laguna Province, Ube, March 24, 1929 (*McGregor*), allotype, male.

Limonia riverai is related to *L. bidentata* (Skuse), differing markedly in the long conspicuous costal fringe. Neither Edwards nor Brunetti mentions the costal fringe of *L. nigra* (Brunetti) as being of unusual length and it is presumably short as in *bidentata*, of which Edwards makes *nigra* a synonym.

LIMONIA (LIMONIA) UBENSIS sp. nov.

General coloration polished black; fore femora black, paler basally, remaining femora yellow, the tips narrowly blackened; wings with a brownish tinge; Sc ending about opposite one-third the length of Rs, Sc_2 at its tip; male hypopygium with the dorsal dististyle lacking; ventral dististyle an oval lobe, the long rostral prolongation subapical in position, with a single rostral spine.

Male.—Length, about 4.2 millimeters; wing, 4.8.

Maxillary palpi small, apparently reduced to two segments, obscure brownish yellow, the outer segment blackened. Antennæ black, the scapal segments paler; flagellar segments subglobular, crowded, the outer segments becoming more slender and elongate; verticils of the outer segments long and conspicuous. Head shiny black; anterior vertex wide.

Thorax shiny polished black, the posterior lateral portions of the scutal lobes paler. Pleura black, the sternopleurite and anepisternum paler, brown. Halteres dusky, the knobs conspicuously light yellow. Legs with the coxæ whitish, the trochanters somewhat darker; fore femora brownish black, the bases narrowly obscure yellow; posterior and middle femora yellow, the tips narrowly dark brown; remainder of legs brownish black. Wings (fig. 5) relatively broad, with a brownish tinge, the basal portion clearer; stigma barely indicated; veins brownish black. Venation: Sc_1 ending at near one-third the length of Rs, Sc_2 at

its tip; free tip of Sc_2 and R_2 in transverse alignment; m-cu shortly before the fork of M, longer than the distal section of Cu_1.

Abdomen, including the hypopygium, black; subterminal segment whitish. Male hypopygium (fig. 36) with the tergite, 9*t*, transverse, the caudal margin gently emarginate, each lateral angle with a chiefly transverse linear series of about eight setæ. Basistyle, *b*, relatively small, the ventromesal lobe very large, occupying the entire face of the style, evenly rounded. Dorsal dististyle lacking. Ventral dististyle, *d*, an elongate-oval lobe, the rostral prolongation nearly terminal in position, appearing as a slender yellow blade that is gently curved near apex; a single rostral spine that is placed laterally near the base of the prolongation pale, broad-based, narrowed gradually to a long slender point. Gonapophyses, *g*, broad-based, narrowed to the blunt tips, the lateral margin before apex microscopically roughened. Ædeagus, *a*, broad.

LUZON, Laguna Province, Ube, Mount Banahao, May 13, 1929 (*McGregor*), holotype, male.

Limonia ubensis is most closely allied to the Formosan *L. fraudulenta* Alexander, differing especially in the coloration and structure of the male hypopygium.

LIMONIA (LIMONIA) RETRUSA sp. nov.

General coloration of mesonotum shiny black; pleura obscure yellow; head black, variegated with silvery white, halteres black; legs black, the tarsi paling to yellowish brown; wings brown; Sc_1 ending beyond midlength of Rs; male hypopygium with the mesal apical angles of the gonapophyses appearing as curved black spines.

Male.—Length, about 4.6 millimeters; wing, 5.2.

Rostrum and palpi dark brown. Antennæ with the first scapal segment brown, the second brownish black; flagellum broken. Front and anterior vertex silvery white, the posterior vertex blackened, broadly interrupted by conspicuous silvery areas on the posterior orbits; sides of head more pruinose.

Pronotum black, obscure yellow laterally. Mesonotal præscutum obscure yellow with three confluent shiny black stripes that form a dorsal shield; remainder of mosonotum blackened, the central portion of the scutum obscure yellow. Pleura obscure yellow, the dorsopleural region vaguely darkened. Halteres black, the extreme base of the stem yellow. Legs with the fore coxæ dark brown, the remaining coxæ and trochanters

obscure yellow; femora black, the proximal ends yellow; tibiæ black; tarsi paling to yellowish brown. Wings (fig. 6) with a strong brown tinge, the oval stigma a little darker than the ground color; veins dark brown. Venation: Sc_1 ending beyond midlength of Rs, Sc_2 at its tip; free tip of Sc_2 and R_2 in approximate transverse alignment; m-cu at fork of M.

Abdomen dark brown, the hypopygium a trifle brighter. Male hypopygium (fig. 37) with the tergite, 9*t*, transverse, the caudal margin gently notched, each lobe with a marginal row of about six setæ. Basistyle, *b*, elongate, the ventromesal lobe very low and inconspicuous. Dorsal dististyle a slender straight spine that lies in a furrow on the face of the ventral dististyle, the latter, *vd*, oval, produced apically into a beak that lacks rostral spines; a blackened chitinized ridge lying above the dorsal dististyle. Gonapophyses, *g*, with the mesal-apical lobe a curved blackened spine.

LUZON, Laguna Province, Ube, Mount Banahao, May 27, 1929 (*McGregor*), holotype, male.

Limonia retrusa is most similar, but apparently not closely allied, to such species as *L. fraudulenta* Alexander and *L. ubensis* sp. nov.

LIMONIA (LIMONIA) PACATA sp. nov.

Size very small (wing, female, 3.8 millimeters); general coloration yellowish brown; head dark gray; halteres and legs brown; wings faintly tinged with brown; cell M_2 open by the atrophy of m; caudal margins of abdominal segments narrowly darkened.

Female.—Length, about 3.5 millimeters; wing, 3.8.

Rostrum and palpi brown. Antennæ brownish black throughout; flagellar segments oval, distinctly separated. Head dark gray; anterior vertex reduced to a narrow strip.

Mesonotum uniformly yellowish brown, unmarked, the scutellum a little darker; præscutum relatively high. Pleura obscure yellow. Halteres brownish black, the base of the stem pale. Legs with the coxæ and trochanters obscure yellow; remainder of legs dark brown. Wings (fig. 7) with a faint brownish tinge, the oval stigma slightly darker brown; veins dark brown. Costal fringe relatively long. Venation: Sc_1 ending about opposite one-third the length of Rs, Sc_2 at its tip; free tip of Sc_2 and R_2 in alignment; cell M_2 open by atrophy of m; cell M_3 about as long as its petiole; m-cu close to the fork of M.

Abdominal tergites dark brown, the caudal margins of the segments narrowly blackened; sternites more brownish yellow,

the caudal margins of the intermediate segments similarly darkened. Ovipositor horn-color; tergal valves small and slender, upcurved; sternal valves stout and straight, their bases conspicuously blackened.

LUZON, Laguna Province, above Ube, altitude about 500 meters, June 10, 1928 (*McGregor*), holotype, female; May 18, 1929 (*Duyag*), paratype, female.

Limonia pacata can be distinguished from similar small species of the subgenus by the venation.

LIMONIA (LIMONIA) SUBALBITARSIS sp. nov.

General coloration polished black; halteres and legs black, the tarsi extensively snowy white; wings tinged with blackish; m-cu beyond the fork of M; male hypopygium with a single rostral spine on the ventral dististyle; basistyle with the ventromesal lobe still further produced into a slender cylindrical lobule.

Male.—Length, about 6.8 to 7 millimeters; wing, 7.5 to 8.

Female.—Length, about 6.3 to 6.4 millimeters; wing, 6.5 to 7.

Rostrum and palpi dark brown. Antennæ brownish black throughout. Head polished black, the front and anterior vertex more opaque, sparsely silvery; anterior vertex broad in both sexes.

Mesonotum chiefly polished black, the humeral and lateral portions of the præscutum, median region of scutum, and lateral portions of postnotum paling to obscure yellowish brown. Pleura obscure brownish yellow. Halteres black, the extreme base of the stem yellow. Legs with the coxæ and trochanters obscure yellow; femora and tibiæ brownish black; tarsi chiefly snowy white, the proximal ends of the basitarsi of fore and middle legs extensively blackened, of the posterior legs entirely snowy white. Wings (fig. 8) strongly tinged with blackish, the apex somewhat darker; veins black. Venation: Sc long, Sc_1 ending beyond three-fourths the length of the long arcuated Rs, Sc_2 some distance from the tip of Sc_1; R_{1+2} subequal to R_2; m-cu in almost all cases more than one-half its length beyond the fork of M and only a little shorter than the distal section of Cu_1.

Abdominal tergites black, each with a broad obscure yellow ring shortly before the caudal margin which is narrowly blackened; sternites more extensively yellow, the incisures narrowly blackened; subterminal segments blackened to form a narrow ring; eighth segment pale; hypopygium brown. Male hypopygium (fig. 38) with the tergite, 9*t*, unusually narrow, transverse,

its caudal margin straight. Basistyle, *b*, long and slender; ventromesal lobe low, further produced into a cylindrical darkened lobule that is set with six to eight small spines. Dorsal dististyle a small straight darkened rod. Ventral dististyle, *vd*, fleshy, the rostral prolongation yellow, near apex with a single long powerful spine. Gonapophyses with the mesal-apical lobe long and straight. Ovipositor with the tergal valves small, slender, much smaller than the sternal valves, the latter straight, conspicuously blackened at base.

LUZON, Laguna Province, Ube, Mount Banahao, May 20, 1929 (*McGregor*), holotype, male; allotype, female; paratypes, four males and females, May 19 and 20, 1929 (*McGregor*); males, June 2, 1929 (*Duyag*). "This fly was resting on a spider web, not hanging from it."—MCGREGOR.

Limonia subalbitarsis is most closely allied to *L. albitarsis* (Alexander) of Java, differing especially in the coloration and details of venation. The details of structure of the male hypopygium of *albitarsis* have not been described.

LIMONIA (LIMONIA) TRIGONOIDES SUBTRIGONOIDES subsp. nov.

Closely similar to the typical form, *Limonia trigonoides* Alexander (Federated Malay States and Sumatra, east to Buru), differing chiefly in slight details of structure of the male hypopygium.

Male.—Length, about 7 millimeters; wing, 8.8.

Antennæ with the terminal segment shorter than the preceding two segments taken together. Frons and anterior vertex blackened, not silvery. Median dark vitta of præscutum scarcely indicated. Pleura with the major portion of the sternopleurite pale. Knobs of halteres blackened. Wings (fig. 9) with R_2 more transverse or bent slightly backward; Rs shorter than in the typical form. Male hypopygium (fig. 39) with the dorsal dististyle, *dd*, a shorter curved hook, not sinuous as in the typical form. Rostral prolongation of ventral dististyle, *vd*, and the spine at its base shorter.

LUZON, Laguna Province, Ube, Mount Banahao, swept from low ferns, May 12, 1929 (*McGregor*).

LIMONIA (GONIODINEURA) NIGRICEPS (van der Wulp).

Goniodineura nigriceps VAN DER WULP, Tijd. voor Ent. 38 (1895) 37–38, pl. 2, fig. 3.

Majayjay, Laguna Province, Luzon, on grass and shrubs, June 3, 1928 (*McGregor*). Badajoz, Tablas, Romblon Province,

August 29, 1928 (*Rivera and Duyag*). Santa Ines, Rizal Province, Luzon, December, 1926 (*Rivera and Duyag*).

LIMONIA (RHIPIDIA) PULCHRA (de Meijere).

Rhipidia pulchra DE MEIJERE, Bijd. tot de Dierkunde 18 (1904) 92, pl. 8, fig. 7.

One female, Ube, Laguna Province, Luzon, March 31, 1929 (*McGregor*).

LIMONIA (GERANOMYIA) ARGENTIFERA (de Meijere).

Geranomyia argentifera DE MEIJERE, Tijd. voor Ent. 56 (1911) 29, pl. 2, figs. 18, 19.

Ube, Laguna Province, Luzon, March, 1928 (*Duyag*).

LIMONIA (THRYPTICOMYIA) APICALIS (Wiedemann).

Limnobia apicalis WIEDEMANN, Aussereur. zweifl. Ins. 1 (1828) 551.

Majayjay, Laguna Province, Luzon, February 22, 1929 (*McGregor*). "Abundant in shade of coffee and other shrubs, hanging by forelegs from spider lines, one or two up to six or eight on a line."

LIMONIA (THRYPTICOMYIA) MICROSTIGMA (Alexander).

Dicranomyia microstigma ALEXANDER, Ann. & Mag. Nat. Hist. IX 8 (1921) 546–547.

Described from North Queensland. One male, Loquilocon, Samar, in cool forest near stream, June 15, 1924 (*McGregor*).

ORIMARGA RELICTA sp. nov.

General coloration blue-gray; legs black; wings brownish gray, with narrow vague darkenings on certain of the veins; R_1 and R_2 in approximate alignment; R_{1+2} evident as a distinct spur.

Female.—Length, about 5.5 millimeters; wing, 4.6.

Rostrum black, nearly as long as the remainder of the head; palpi black. Antennæ black throughout, relatively elongate, if bent backward extending about to the wing root; flagellar segments long-oval. Head gray, the genæ more dusky, the anterior vertex more silvery gray.

Mesonotum and pleura blue-gray, without distinct markings. Halteres obscure yellow, the knobs dusky. Legs with the coxæ blue-gray; trochanters dusky; remainder of legs black. Wings (fig. 10) with a brownish gray suffusion; a very narrow and vague dusky seam along the outer costa to the wing tip, more evident in the radial field; narrow dark seams at origin of Rs, end of R_1 and on R_2, and on m-cu, most evident as a darkening of the veins; veins light brown, the incrassated costa more yel-

lowish brown. Macrotrichia on all the longitudinal veins beyond the cord between and including R_3 and M_4. Venation: Sc_1 ending opposite midlength of Rs, Sc_2 at its extreme tip; free tip of Sc_2 usually preserved; R_1 in approximate alignment with R_2; R_{1+2} evident as a short spur; m-cu beyond midlength of Rs and about opposite Sc_2; vein 2d A elongate.

Abdominal tergites black, the basal sternites more yellowish; genital segment obscure yellow, the small valves of the ovipositor brown.

LUZON, Laguna Province, Ube, Mount Banahao, March 29, 1929 (*McGregor*).

Orimarga relicta is a very interesting species that shows well the manner of loss of veins in the radial field in this group of crane flies. The venation separates it from all regional species although this is generally similar to that of *O. punctipennis* Alexander, of British Guiana.

EURHAMPHIDIA NIGROFEMORATA sp. nov.

General coloration brown; legs dark brown, the genua not brightened; tips of tibiæ and all tarsi snowy white; wings subhyaline, the stigma grayish brown; veins R_3 and R_{4+5} relatively short and widely divergent.

Female.—Length, about 5.5 millimeters; wing, 4.8.

Rostrum dark brown, a little brightened at base; palpi dark. Antennæ with the basal segment pale brown; second segment blackened; flagellum broken. Head dark brownish gray, clearer silvery gray in front.

Mesonotum uniformly dark brown, the lateral margins of the præscutum restrictedly pale; scutellum somewhat darker brown, margined posteriorly with pale. Pleura testaceous yellow, the sternopleurite a little darkened and vaguely pruinose; posterior sclerites clearer yellow. Halteres infuscated, the base of the stem narrowly pale yellow. Legs with the coxæ and trochanters pale yellow, the fore coxæ a trifle more infuscated; femora brownish black, the bases very narrowly and vaguely paler, the tips not at all brightened; tibiæ black, the tips broadly snowy white, the amount narrowest on the forelegs where it includes between one-fourth and one-fifth the segment, more extensive on the midtibia where it includes the distal two-fifths; porterior legs broken beyond the femora; tarsi snowy white, the terminal segments more darkened. Wings (fig. 11) hyaline, the long-oval stigma grayish brown; veins brown. Venation: Sc long, Sc_1 ending only shortly before the fork of Rs, Sc_2 at

its tip; veins R_3 and R_{4+5} relatively short and widely divergent; m-cu about two-thirds its length beyond the fork of M; vein 2d A relatively short.

Abdominal tergites uniformly dark brown, the sternites obscure yellow. Ovipositor yellowish, the valves darker, especially the slender tergal valves which are blackened, paling to yellow at tips.

LUZON, Laguna Province, above Ube, Mount Banahao, altitude about 800 meters, in cool damp forest, swept from low ferns and other herbage, May 18, 1929 (*McGregor*), holotype, female.

Eurhamphidia nigrofemorata is readily told from allied species by the leg pattern. It is apparently most nearly related to *E. inelegans* Alexander (Formosa), differing especially in the smaller size and entire absence of pale color on the genua.

EPIPHRAGMA BAKERI Alexander.

Epiphragma bakeri ALEXANDER, Philip. Journ. Sci. 21 (1922) 373–374.

The type, a male, was from Pauai, Benguet, Luzon. A small series of what are considered as being different subspecies of *bakeri* were taken above Ube, Mount Banahao, Luzon, altitude about 800 meters, swept from low ferns and other vegetation in cool damp forest, May 18, 1929 (*McGregor*).

These varietal or subspecific forms are very puzzling and their exact value must remain in doubt. They may be separated by the following key:

1. Tibiæ dark brown ..... *E. bakeri* Alexander.
   Tibiæ light yellow. 2.
2. Mesonotum uniformly ocherous, without distinct marks; pleura dark, only the ventral sternopleurite brightened; supernumerary crossveins and spurs in cell C few (5 or 6) ..... *E. b. ochrinota* subsp. nov.
   Mesonotum variegated with darker; pleura variegated with dark brown and yellow; supernumerary crossveins and spurs in cell C more numerous (exceeding 8) ..... 3.
3. Sternopleurite conspicuously dark brown; petiole of cell M_1 short, subequal to m ..... *E. b. fuscosternata* subsp. nov.
   Sternopleurite conspicuously light yellow; petiole of cell M_1 long, more than three times m ..... *E. b. flavosternata* subsp. nov.

EPIPHRAGMA BAKERI OCHRINOTA subsp. nov.

Female.—Length, about 10 millimeters, wing, 8.5.

Antennæ with the basal three segments of flagellum yellow. Posterior vertex dull reddish brown, the central portion darker. Mesonotum uniformly pale ocherous, the caudal margin of the postnotal mediotergite narrowly dark brown. Pleura conspicuously dark brown, only the ventral sternopleurite obscure

yellow. Femora yellow, with a narrow brown subterminal ring; tibiæ yellow. Wings with the ground color brownish yellow, the prearcular and costal regions clearer yellow; dark pattern restricted, appearing as a postarcular area; a broken band at level of origin of Rs; a continuous band at cord; outer end of cell 1st M_2; and as marginal brown spots at ends of longitudinal veins; a slightly paler brown wash in the radial and medial fields distad of cord. No darkening of axilla. Venation: Only four or five crossveins and spurs in cell C; inner end of cell 1st M_2 only gently arcuated; petiole of cell M_1 short, subequal to m. Abdomen almost uniformly brown, only vaguely marked with obscure yellow. Holotype, female.

EPIPHRAGMA BAKERI FUSCOSTERNATA subsp. nov.

Female.—Length, about 11 millimeters; wing, 9.

Mesonotal præscutum and scutal lobes extensively dark brown. Pleura chiefly pale yellow, variegated with dark brown, this color including a ventral longitudinal stripe that extends from the base of the halteres, passing above the midcoxæ and darkening the ventral sternopleurite; dorsopleural region darkened. Femora obscure brownish yellow, with a broad brown subterminal ring, the apex yellow; tibiæ yellow. Wings with a heavy secondary grayish brown pattern between the darker brown areas, restricting the yellow ground color to conspicuous borders to all dark areas; axillary region darkened. Venation: Costal crossveins and spurs numerous; inner end of cell 1st M_2 not arcuated, in alignment with the other elements of the cord; petiole of cell M_1 short, subequal to m. Holotype, female.

EPIPHRAGMA BAKERI FLAVOSTERNATA subsp. nov.

Male.—Length, about 8 millimeters; wing, 9.

Mesonotal præscutum chiefly pale, the median area behind more darkened; scutal lobes yellow, the median area dark brown. Pleura chiefly brown, the sternopleurite conspicuously light yellow. Femora dark brown, the tips narrowly yellow; tibiæ light yellow. Wings with a light secondary grayish brown pattern between the heavy brown areas; axillary region darkened; a series of marginal dark spots on all longitudinal veins. Venation: Costal crossveins and spurs numerous; petiole of cell M_1 elongate, more than three times m; inner end of cell 1st M_2 not arcuated, in alignment with the other elements of the anterior cord. Holotype, male.

ERIOCERA LATIVENTRIS Bezzi.

Eriocera lativentris BEZZI, Philip. Journ. Sci. 12 § D (1917) 113.

One male, Majayjay, February 24, 1929 (*McGregor*). "Resting on upper surface of a large leaf, it suggested a hymenopteron or a slender hemipteron."

ERIOCERA VERTICALIS (Wiedemann).

Megistocera verticalis WIEDEMANN, Aussereur. zweifl. Ins. 1 (1828) 56.

Male, Lucban, Tayabas, Luzon, May 20, 1926 (*McGregor*). "In shade, by side of small stream."

ELEPHANTOMYIA (ELEPHANTOMYODES) SAMARENSIS Alexander.

Elephantomyia samarensis ALEXANDER, Philip. Journ. Sci. 28 (1925) 372–373.

The interesting observations by Mr. McGregor add this genus to the ever-increasing list of white-footed crane flies that are associated with spider webs.

Majayjay, Luzon, June 1 to 3, 1928, flying in light forest (*McGregor*). Ube, Luzon, May 13, 1929, two males, hanging from a horizontal spider line, much as in *Thrypticomyia* and *Euglochina* in the same locality (*McGregor*). Majayjay, June 2, 1928, hanging by forefeet from spider line (*McGregor*).

GNOPHOMYIA FILIFORMIS sp. nov.

Mesonotal præscutum reddish brown with three dark brown stripes; antennæ (male) elongate; pleura brownish yellow, the anepisternum and pleurotergite each with a velvety black area; Sc long, extending to beyond the oblique R_2; cell 1st M_2 relatively small; male hypopygium with the ædeagus and gonapophyses very elongate, filiform.

Male.—Length, about 5.5 millimeters; wing, 5.8; antenna, about 3.2.

Female.—Length, about 4.8 millimeters; wing, 5; antenna, about 2.4.

Rostrum yellow; palpi black. Antennæ (male) elongate, as shown by the measurements; dark brown; flagellar segments elongate-cylindrical, clothed with a dense erect white pubescence, each segment with a single relatively short verticil at about one-third the length of the segment. Head blackened, the orbits and anterior vertex narrowly light gray.

Mesonotal præscutum reddish brown, with three dark brown stripes; humeral region obscure yellow, much constricted; surface of præscutum behind with parallel transverse impressed

lines; scutal lobes extensively brownish black, the posterior lateral portions obscure yellow; scutellum brownish testaceous; postnotum blackened, sparsely pruinose. Pleura chiefly pale brownish yellow; a large circular velvety black area on the anepisternum and a second similar area occupying most of the pleurotergite, the two areas interrupted by the uniformly pale pteropleurite; ventral sternopleurite weakly infumed. Halteres black, the base of the stem restrictedly pale yellow, the knobs obscure yellow. Legs with the coxæ pale brown, the fore coxæ a little darker; trochanters brownish yellow; femora light yellowish brown, the bases somewhat clearer; tibiæ a little darker; tarsi passing into brown. Wings (fig. 12) grayish, weakly tinged with brown on proximal half; stigmal region pale brown, ill-delimited; veins brownish black. Venation: Sc_1 extending to shortly beyond the oblique R_2; cell 1st M_2 relatively small; m arcuated to weakly angulated, nearly twice as long as the basal section of M_3; m-cu approximately its own length beyond the fork of M.

Abdomen brown, the hypopygium darker brown. Male hypopygium (fig. 40) with the tergal region only weakly chitinized, appearing as a flattened pale plate, the lateral portions only slightly more chitinized. Dististyles inserted in a notch on the mesal face of the basistyle; outer dististyle, *od*, a yellow boomerang-shaped glabrous structure; inner dististyle blackened and provided with numerous long delicate setæ. Ædeagus, *a*, and subtending apophyses, *g*, extending back into the abdomen as far as segment six. Ovipositor (fig. 41) with the tergal valves compressed, deep, gently upcurved to the subobtuse tips, the surface with a few setæ, including a more powerful one close to apex.

LUZON, Laguna Province, above Ube, Mount Banahao, altitude about 800 meters, in cool damp forest, swept from low ferns and other herbage, May 18, 1929 (*McGregor*), holotype, male; allotype, female, in copula with the type.

Gnophomyia filiformis is very distinct from all similar species in the Oriental fauna. The antennæ of the male of this and the next species are unusually elongate.

GNOPHOMYIA MACROCERA sp. nov.

General coloration black, pruinose; antennæ (male) elongate; halteres brownish black; wings with a dusky suffusion; male hypopygium with the inner dististyle blackened, the innermost arm broad, with a curved blackened spine on its disk.

Male.—Length, about 4 millimeters; wing, 4.5; antenna, about 3.3.

Rostrum and palpi black. Antennæ black, elongate in the male, exceeding three-fourths the length of the body; flagellar segments elongate-cylindrical, with an erect pubescence and a whorl of about three verticils at near one-third the length, the longest of these verticils about two-thirds the length of the segment; terminal segment a little shorter than the penultimate. Head black, pruinose.

Mesonotum black, the surface pruinose. Pleura gray, the anepisternum and pleurotergite more velvety black. Halteres brownish black, the extreme base of the stem obscure yellow. Legs with the coxæ black, pruinose; trochanters dark brown; remainder of legs black, the femoral bases restrictedly obscure yellow. Wings (fig. 13) with a dusky suffusion, the elongate stigma more infuscated; veins black. Venation: Sc_1 ending nearly opposite the slightly oblique R_2; cell 1st M_2 relatively large, m and the basal section of M_3 subequal, nearly straight; m-cu a little more than its length beyond the fork of M.

Abdomen, including the hypopygium, black. Male hypopygium (fig. 42) with the basistyle, *b*, short and stout, the dististyles terminal in position; outer dististyle, *od*, a glabrous arcuate rod; inner dististyle, *id*, large and conspicuous, blackened, the outer arm slender, setiferous; inner arm broad, the tip obtuse, before apex on disk with a curved blackened spine. Ædeagus short.

LUZON, Laguna Province, Ube, Mount Banahao, May 20, 1929 (*McGregor*), holotype, male; paratypes, males and females, March 29 and May 27, 1929 (*McGregor*); May 10 and 26 and June 3, 1929 (*Duyag*).

GONOMYIA (LIPOPHLEPS) LONGIRADIALIS sp. nov.

General coloration of mesonotum dark brown; antennæ brownish black throughout; pleura yellow, with a blue-gray longitudinal stripe; legs black; wings tinged with brown; Sc long, Sc_1 extending to about opposite one-third the length of the long Rs; cell 1st M_2 closed; m-cu at fork of M; male hypopygium with the single dististyle fleshy.

Male.—Length, about 2.8 millimeters; wing, 3.3.

Female.—Length, about 3.5 millimeters; wing, 3.5.

Rostrum yellowish brown; palpi dark brown. Antennæ brownish black throughout. Head chiefly dark, sparsely pruinose.

Pronotum and anterior lateral pretergites yellowish white. Mesonotum dark brown; scutellum brown basally, paling to yellow at apex; postnotal mediotergite dark brown, sparsely pruinose, the cephalic lateral portions more yellowish. Pleura yellow, with a blue-gray longitudinal stripe extending from the propleura to the base of the abdomen. Halteres dusky, the knobs dirty yellow. Legs with the coxæ yellow, the outer faces weakly infuscated; trochanters obscure yellow; remainder of legs black, the femoral bases scarcely brightened. Wings (fig. 14) tinged with brown, the stigma scarcely darker; veins dark brown. Venation: Sc_1 ending about opposite one-third the length of the very long Rs, Sc_2 at its tip; Rs only a trifle shorter than the anterior branch of Rs; m-cu at fork of M.

Abdominal tergites dark brown, the sternites and hypopygium brighter. Male hypopygium (fig. 43) with the apex of each basistyle, *b*, produced into a small fleshy lobe. Dististyle, *d*, single, entirely fleshy, of approximately similar shape and size as the apical lobe of the basistyle. Phallosome, *p*, very complicated, terminating in five distinct arms that are shaped about as in the figure.

LUZON, Laguna Province, Ube, Mount Banahao, March 31, 1929 (*McGregor*), holotype, male; allotype, female, May 27, 1929 (*McGregor*).

Gonomyia longiradialis is entirely distinct from the numerous regional species of the subgenus *Lipophleps* in the elongate Rs, with Sc_1 ending about opposite one-third its length. The venational characters given as definitive for *Lipophleps* by Edwards[4] will thus require a slight modification.

TRENTEPOHLIA (PARAMONGOMA) BANAHAOENSIS sp. nov.

General coloration pale brown, the mesonotal præscutum yellow; femora brown, the tips narrowly whitened; terminal tarsal segments paling to yellow; wings grayish, the narrow stigma a little darker; abdominal tergites brown.

Female.—Length, about 4 millimeters; wing, 4.2.

Rostrum reduced, yellow; palpi small. Antennæ with the basal segment yellow; second segment brown; flagellum black; segments gradually decreasing in size outwardly. Head yellowish brown; eyes virtually contiguous dorsally.

Mesonotal præscutum yellow, with a capillary, more or less impressed, median brown vitta; posterior sclerites of mesonotum

[4] Journ. Fed. Malay States Mus. 14 (1928) 103.

more brownish testaceous, the centers of the scutal lobes more infumed. Pleura pale testaceous yellow, the dorsal portions weakly darkened. Halteres pale, the knobs slightly infumed. Legs with the coxæ pale yellow; trochanters testaceous yellow; femora brown, the tips very narrowly whitened; remainder of legs brown, the terminal tarsal segments paling to yellow, the color including the tips of the basitarsi and the succeeding segments with the exception of the darkened terminal segment. Wings (fig. 15) grayish; stigma a little darker, restricted to a narrow clouding on R_2 and R_{1+2} ; veins brown, the prearcular, costal, subcostal, and cubital veins a little paler. Venation: Sc_1 ending just beyond the level of the fork of Rs; Sc_2 about opposite two-fifths the length of Rs; cell Cu widely open, the distance on the margin exceeding the distal section of Cu_1.

Abdominal tergites brown, the sternites somewhat more brownish yellow; genital segment yellow; valves of ovipositor brownish horn-color.

LUZON, Laguna Province, Ube, Mount Banahao, May 20, 1929 (*McGregor*), holotype, female.

Trentepohlia banahaoensis is the first species of the subgenus *Paramongoma* Brunetti to be recorded from the Philippines. It is most closely allied to *T.* (*P.*) *pusilla* Edwards (Sebesi), from which it differs in slight details of coloration and venation of the radial field.

TRENTEPOHLIA (MONGOMA) RICARDI sp. nov.

General coloration shiny yellow; head gray; posterior portion of mesonotal præscutum, the scutal lobes, two areas on scutellum, and the postnotal mediotergite darkened; legs yellow, the femoral tips, tibial bases, and tips and proximal ends of the basitarsi narrowly blackened; wings grayish white, the costal region clear luteous, the apex very narrowly darkened.

Male.—Length, 6.5 to 7.3 millimeters; wing, 6.5 to 7.3.

Female.—Length, 8.5 to 11 millimeters; wing, 7 to 8.

Rostrum and palpi pale. Antennæ (male) elongate for a member of this genus, if bent backward extending to beyond the base of abdomen; scape blackened; flagellum whitish, the outer segments vaguely darkened; flagellar segments cylindrical, with a short dense pubescence. In the female the antennæ are shorter, extending about to the base of the halteres, the scape paler. Head of male blackish, more or less pruinose, of female somewhat paler, the narrow anterior vertex more silvery.

Mesonotum shiny yellow, the posterior portion of the præscutum, scutal lobes, two areas on scutellum, and the center of the postnotal mediotergite darkened. Pleura yellow. Halteres yellow, the base of the knobs a little darkened. Legs with the coxæ and trochanters pale yellow; femora yellow, the tips narrowly but conspicuously blackened; a more whitish ring immediately before the blackened portion, the genua again restrictedly pale; tibiæ pale yellow, the bases narrowly, the tips more broadly blackened; tarsi yellow, the extreme proximal end of the basitarsus blackened. Basal armature of femora consisting of erect setæ only. Wings (fig. 16) grayish white, the costal margin clear luteous; some of the veins, especially in the radial field, along cord, and in the anal field narrowly darkened; wing apex narrowly darkened; veins black, the prearcular veins, C, Sc, and R conspicuously pale yellow. Venation: Rs approximately one-half R_{2+3+4}; R_2 close to fork of R_{3+4}; cell 1st M_2 relatively small; m-cu about one-half to fully its own length beyond the fork of M; fusion of Cu_1 and 1st A slight.

Abdominal tergites brownish yellow, darkest medially; sternites and hypopygium clearer yellow.

LUZON, Laguna Province, Ube, Mount Banahao, March 30, 1929 (*McGregor*), holotype, male; allotype, female; paratypes, several of both sexes, March 27 to May 26, 1929 (*McGregor and Duyag*). One paratype was found resting on leaves of a *Pandanus*.

I take great pleasure in dedicating this species to Mr. McGregor, as a slight appreciation of my indebtedness to him in making known the interesting tipulid fauna of the Philippines. The species is most closely allied to *T.* (*M.*) *kempi* (Brunetti) of Assam, differing in the details of coloration of the body, legs, and wings. It may be observed that no fewer than ten species of *Trentepohlia* have now been taken at and above Ube.

TRENTEPOHLIA (MONGOMA) POLIOCEPHALA Alexander.

Trentepohlia (Mongoma) poliocephala ALEXANDER, Philip. Journ. Sci. 40 (1929) 266.

A few additional specimens, Ube, March 30, 1929 (*McGregor*). I have recently seen a specimen of this same species from Palm Island, North Queensland, taken May 1, 1929, by J. E. Claffey, contained in the collections of the Australian Institute of Tropical Medicine.

The accession of this additional material further demonstrates that the type male has the venation abnormal. In normal specimens, Rs is from one-half longer to nearly twice the length of the basal section of R_5, R_2 is subequal to R_{2+3}, and cell 1st M_2 is larger and more as in other species of the subgenus.

TOXORHINA ANGUSTILINEA sp. nov.

General coloration of head and mesonotum yellow; thoracic pleura yellow with a conspicuous black dorsal stripe; knobs of halteres brownish black; wings with a weak brown tinge; cell M_2 open by the atrophy of m; intermediate abdominal tergites brownish black, variegated with yellow.

Female.—Length, excluding rostrum, about 7.5 millimeters; wing, 5.8; rostrum, about 7.8.

Rostrum approximately as long as the body, black throughout. Antennæ with the scapal segments brownish black, the second a little paler; flagellum broken. Head yellow.

Cervical region black, unusually short, concealed beneath the unusually protruding præscutum, which thus nearly reaches the head. Mesonotal præscutum chiefly yellow, with vague indications of a capillary median vitta and broader sublateral brown stripes; scutellum dusky, margined with obscure yellow; postnotal mediotergite yellow, marked medially with dark brown. Pleura light yellow with a narrow black dorsal stripe extending from the cervical region to the base of the abdomen. Halteres obscure yellow, the knobs brownish black. Legs with the coxæ and trochanters yellow; remainder of legs dark brown. Wings (fig. 17) with a weak brown tinge, the centers of the cells somewhat paler; veins brown. Venation: Sc_1 ending just beyond the origin of Rs; R_1 ending about opposite two-thirds the length of Rs; cell M_2 open by the atrophy of m; petiole of cell M_3 one-half longer than M_4; m-cu before the fork of M.

Abdominal tergites brownish black, the subcaudal portions of tergites four to eight with a conspicuous yellow area, the narrow caudal margins somewhat paler than the blackened basal rings; sternites obscure yellow, the incisures and lateral portions more infuscated; genital segment yellow. Ovipositor with the valves long and straight.

LUZON, Laguna Province, above Ube, Mount Banahao, altitude about 800 meters, in cool damp forest, swept from low ferns and other herbage, May 18, 1929 (*McGregor*), holotype, female.

Toxorhina angustilinea is generally similar to *T. trichorhyncha* Edwards (Borneo), differing in the smaller size, strongly produced præscutum, and short neck. It differs from *T. producta* Edwards (Perak) in the short neck and pale coloration of the mesonotum.

TOXORHINA DUYAGI sp. nov.

General coloration gray; second antennal segment conspicuously yellow; thoracic pleura with the dorsal half gray, the ventral half abruptly ocherous; halteres dark brown; abdominal tergites uniformly dark brown.

Female.—Length, excluding rostrum, about 5 millimeters; wing, 5.2; rostrum, about 5.

Rostrum approximately as long as the body, black. Antennæ black, the second segment conspicuously yellow. Head light gray, the center of the vertex weakly darkened, the front more yellowish gray; no corniculus.

Mesonotal præscutum light gray, with three confluent brown stripes; scutum and scutellum brownish gray, the postnotum clearer blue-gray. Pleura dimidiate, the dorsal half, including the dorsopleural region and pleurotergite gray, the ventral half, including the sternopleurite and meron abruptly ocherous. Halteres dark brown, the base of the stem narrowly yellow. Legs with the coxæ and trochanters ocherous; femora dark brown, their bases brighter; tibiæ and tarsi passing into black. Wings (fig. 18) with a faint dusky tinge; veins black. Venation: Sc_1 ending opposite the origin of Rs, Sc_2 some distance from its tip; cell M_2 open by the atrophy of m; m-cu close to the fork of M.

Abdominal tergites uniformly dark brown, the sternites more obscure yellow, vaguely lined with dusky; hypopygium brownish yellow, relatively large. Male hypopygium (fig. 44) with the median lobe of the tergite, 9*t*, transverse, darkened, the caudal margin truncate. Outer dististyle, *od*, a slender twisted spine. Inner dististyle, *id*, more or less hatchet-shaped. Arms of the ædeagus, *a*, short.

LUZON, Laguna Province, Ube, Mount Banahao, March 22, 1929 (*A. C. Duyag*), holotype, male; paratype, male.

I take pleasure in naming this distinct *Toxorhina* in honor of the collector, who has secured many interesting Tipulidæ near Ube. The species is closest to *T. fasciata* Edwards (Borneo), differing in the coloration of the antennæ, halteres, and abdomen.

ILLUSTRATIONS

[Legend: *a*, ædeagus; *b*, basistyle; *d*, dististyle; *dd*, dorsal dististyle; *g*, gonapophysis; *id*, inner dististyle; *od*, outer dististyle; *p*, phallosome; *s*, sternite; *t*, tergite; *vd*, ventral dististyle.]

PLATE 1

FIG. 1. *Nesopeza oberon* sp. nov., wing.
2. *Tipula fuscoangustata* sp. nov., wing.
3. *Limonia* (*Libnotes*) *illecebrosa* sp. nov., wing.
4. *Limonia* (*Libnotes*) *notata* (van der Wulp), wing.
5. *Limonia* (*Limonia*) *ubensis* sp. nov., wing.
6. *Limonia* (*Limonia*) *retrusa* sp. nov., wing.
7. *Limonia* (*Limonia*) *pacata* sp. nov., wing.
8. *Limonia* (*Limonia*) *subalbitarsis* sp. nov., wing.
9. *Limonia* (*Limonia*) *trigonoides subtrigonoides* subsp. nov., wing.
10. *Orimarga relicta* sp. nov., wing.
11. *Eurhamphidia nigrofemorata* sp. nov., wing.
12. *Gnophomyia filiformis* sp. nov., wing.
13. *Gnophomyia macrocera* sp. nov., wing.
14. *Gonomyia* (*Lipophleps*) *longiradialis* sp. nov., wing.
15. *Trentepohlia* (*Paramongoma*) *banahaoensis* sp. nov., wing.
16. *Trentepohlia* (*Mongoma*) *ricardi* sp. nov., wing.
17. *Toxorhina angustilinea* sp. nov., wing.
18. *Toxorhina duyagi* sp. nov., wing.

PLATE 2

FIG. 19. *Scamboneura dotata* Osten Sacken, male hypopygium, lateral.
20. *Scamboneura dotata* Osten Sacken, male hypopygium, ninth tergite.
21. *Scamboneura dotata* Osten Sacken, male hypopygium, outer dististyle.
22. *Scamboneura dotata* Osten Sacken, male hypopygium, appendage of ninth sternite.
23. *Scamboneura psarophanes* Alexander, male hypopygium, ninth tergite.
24. *Scamboneura psarophanes* Alexander, male hypopygium, outer dististyle.
25. *Scamboneura psarophanes* Alexander, male hypopygium, inner dististyle.
26. *Scamboneura psarophanes* Alexander, male hypopygium, appendage of ninth sternite.
27. *Scamboneura vittivertex* sp. nov., male hypopygium, lateral.
28. *Scamboneura vittivertex* sp. nov., male hypopygium, ninth tergite.
29. *Scamboneura vittivertex* sp. nov., male hypopygium, outer dististyle.

FIG. 30. *Scamboneura vittivertex* sp. nov., male hypopygium, inner dististyle.
31. *Scamboneura vittivertex* sp. nov., male hypopygium, appendage of ninth sternite.
32. *Scamboneura hirtisternata* sp. nov., male hypopygium, lateral.
33. *Scamboneura hirtisternata* sp. nov., male hypopygium, ninth tergite.

PLATE 3

FIG. 34. *Limonia* (*Libnotes*) *illecebrosa* sp. nov., male hypopygium.
35. *Limonia* (*Libnotes*) *riverai* Alexander, male hypopygium.
36. *Limonia* (*Limonia*) *ubensis* sp. nov., male hypopygium.
37. *Limonia* (*Limonia*) *retrusa* sp. nov., male hypopygium.
38. *Limonia* (*Limonia*) *subalbitarsis* sp. nov., male hypopygium.
39. *Limonia* (*Limonia*) *trigonoides subtrigonoides* subsp. nov., male hypopygium.
40. *Gnophomyia filiformis* sp. nov., male hypopygium.
41. *Gnophomyia filiformis* sp. nov., ovipositor.
42. *Gnophomyia macrocera* sp. nov., male hypopygium.
43. *Gonomyia* (*Lipophleps*) *longiradialis* sp. nov., male hypopygium.
44. *Toxorhina duyagi* sp. nov., male hypopygium.

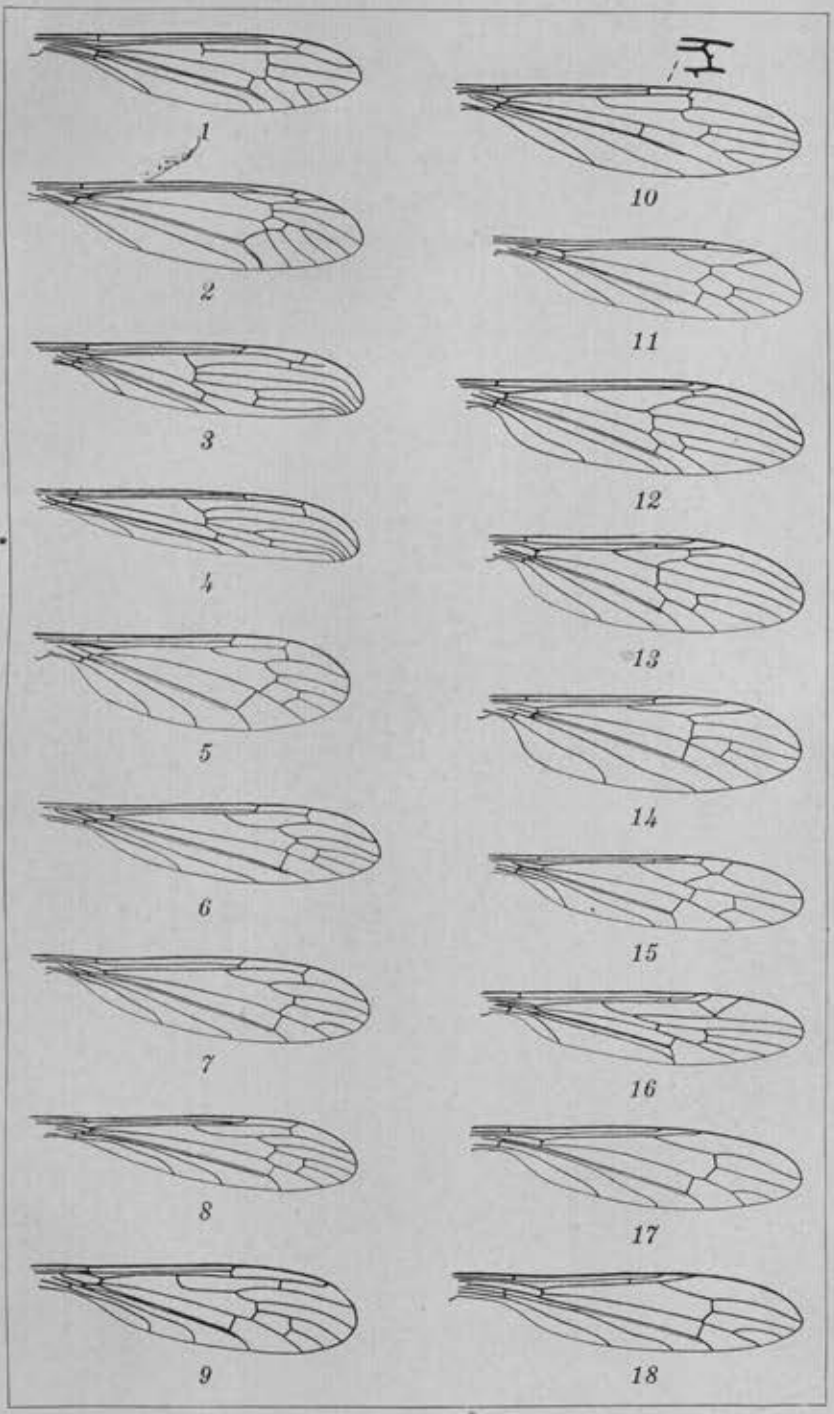


PLATE 1.

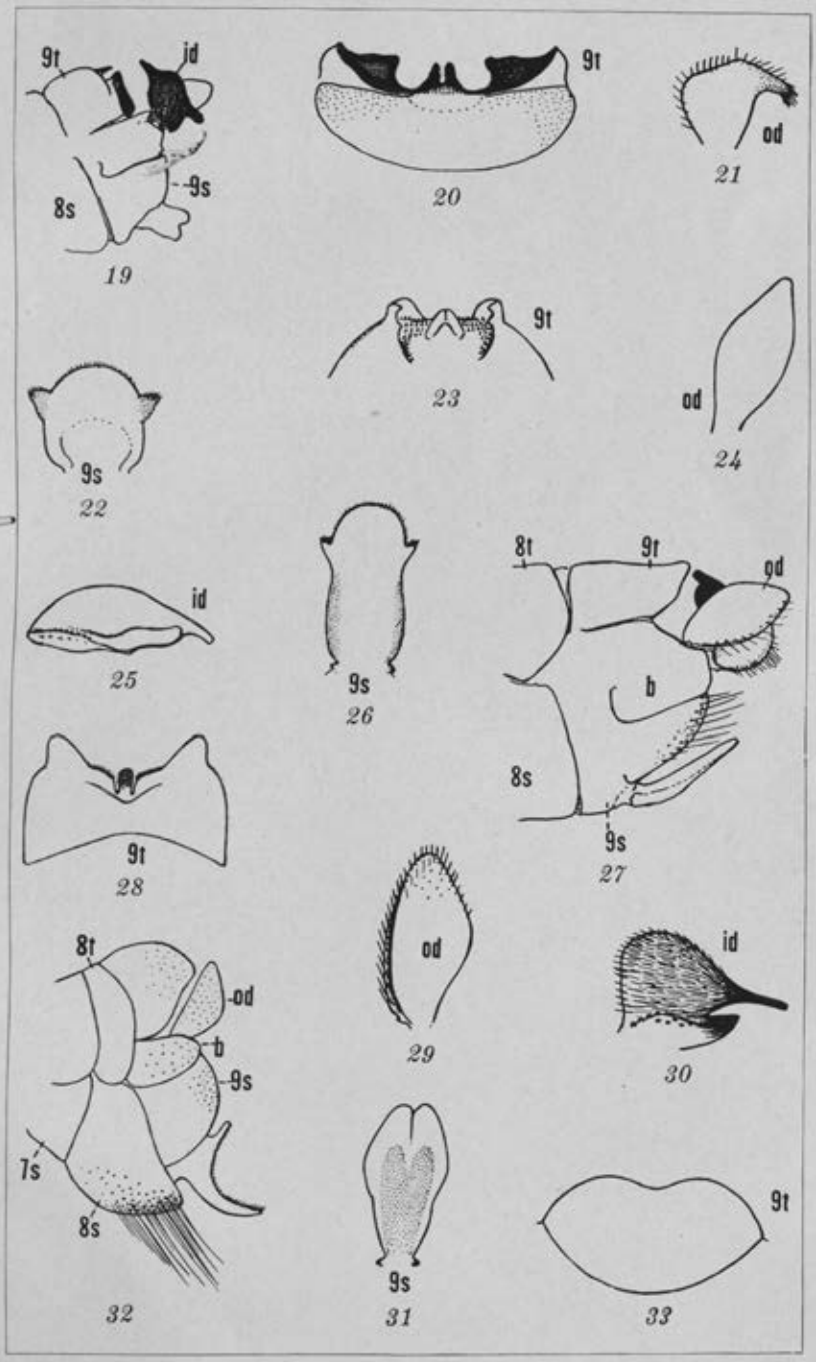

9t
jd
8s
9s
19
9t
20
od
21
9t
23
od
24
9s
22
id
25
9s
26
8t
9t
od
b
8s
9s
27
9t
28
od
29
id
30
8t
od
b
9s
7s
8s
32
9s
31
9t
33

PLATE 2

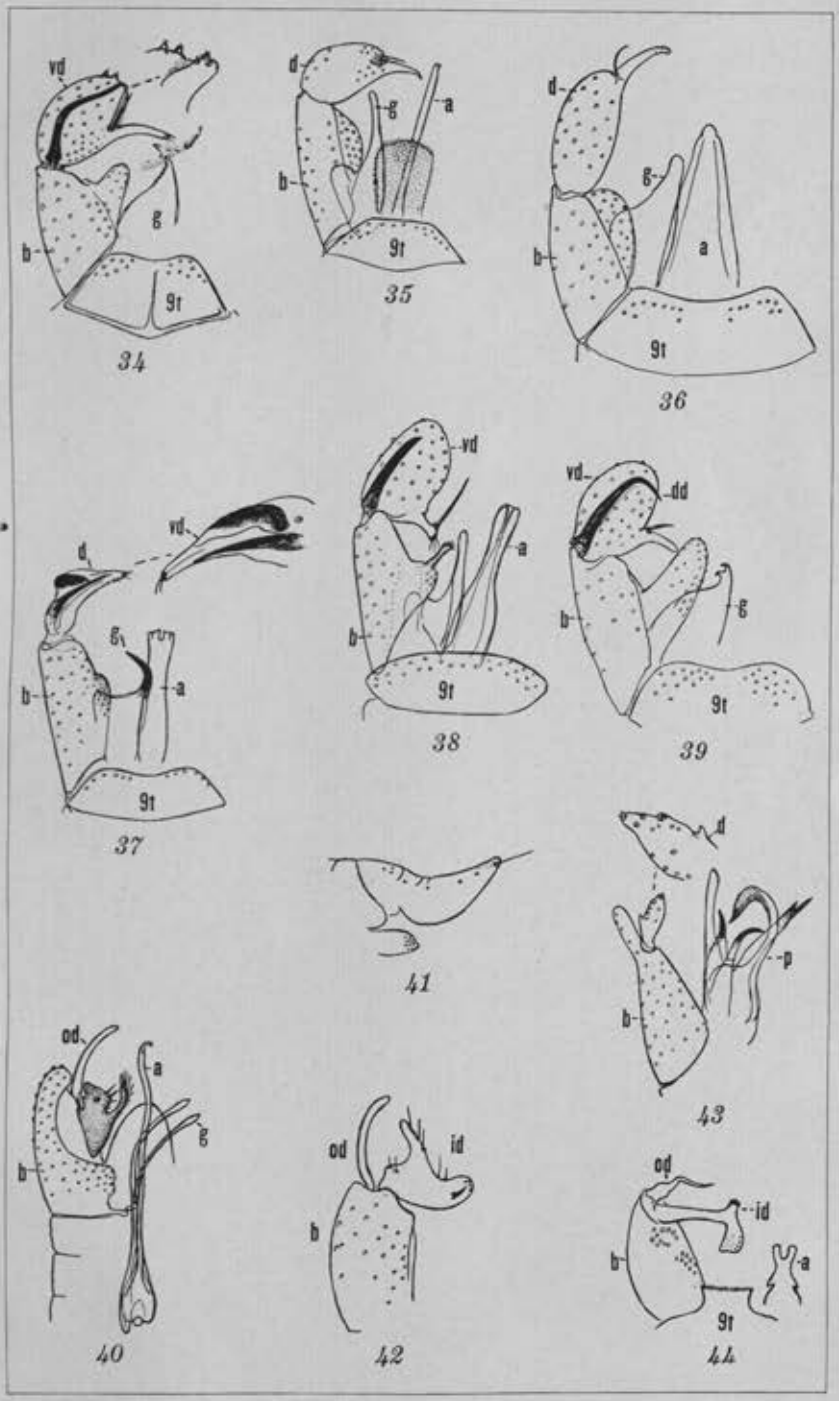

vd
g
b
9t
34
d
g
a
b
9t
35
d
g
a
b
9t
36
vd
d
g
a
b
9t
37
vd
a
b
9t
38
vd
dd
g
b
9t
39
41
d
p
b
43
od
a
g
b
40
od
id
b
42
od
id
a
b
9t
44

PLATE 3.

NEW OR INTERESTING PHILIPPINE PLANTS, I

By EDUARDO QUISUMBING

Botanist, Bureau of Science, Manila

THREE PLATES AND TWENTY-EIGHT TEXT FIGURES

The present contribution is the first of a proposed series of papers. It is planned to include diagnoses of new species, records of various species previously described and now found for the first time in the Philippines, as well as items appertaining to rare and particularly interesting plants. The genus *Thottea* previously unrecorded from the Philippines is included. Six species previously described by various authors from extra-Philippine material are here recorded from the Archipelago for the first time. Twenty-nine species are described as new. A new generic name is proposed for *Petalonema* Schlechter (non Gilg).

Unless otherwise indicated in the text, the actual types of the new species described are deposited in the Bureau of Science herbarium, Manila, with isotypes in the herbarium of the University of California. In a few cases the types are in the University of California herbarium, with isotypes in the Bureau of Science herbarium. The habit sketches are by Messrs. J. M. Salazar and V. Marasigan, draftsmen of the Bureau of Science, and detailed drawings are by the author.

I wish to acknowledge the assistance freely given by Dr. E. D. Merrill, director of the New York Botanical Garden, in the preparation of the manuscript.

GRAMINEÆ

Genus PANICUM Linnæus

PANICUM ACROANTHUM Steud.

Panicum acroanthum STEUD., Syn. Pl. Glum. 1 (1854) 87; FRANCH. and SAV., Enum. Pl. Jap. 2 (1879) 162; HOOK. f., Fl. Brit. Ind. 7 (1897) 53; CAMUS and CAMUS in Lecomte Fl. Gén. de l'Indo-Chine 7 (1922) 451.

BALABAC, Mount Caunayan, *Bur. Sci. 49704 Ramos and Edaño*, November 23, 1927, in secondary forests near streams at low

altitudes, the identification by E. D. Merrill. A species not previously reported from the Philippines. India to Japan, southern China, and Indo-China.

MORACEÆ

Genus FICUS Tournefort

FICUS BALABACENSIS sp. nov. § Urostigma. Plate 1.

Arbor glabra, subepiphytica; ramulis annulatis, glabris; foliis alternis, oblongo-ellipticis ad oblongo-obovatis, firmiter chartaceis ad subcoriaceis, 20 ad 35 cm longis, 9 ad 13 cm latis, supra glabris, subtus parce pubescentibus, acuminatis, basi breviter rotundatis ad subcordatis, nervis lateralibus utrinque 18 ad 21, subtus valde perspicuis; petiolo glabro, 2.5 ad 4 cm longo; stipulis lineari-lanceolatis, chartaceis, persistentibus, glabris, 5 ad 11 cm longis; receptaculis in axillis superioribus plus minusve confertis, sessilibus, solitariis vel in paribus dispositis, ovoideis, 3 to 3.3 cm longis, 2 to 2.5 cm diametro, glabris, laevis.

A strangling fig, the branchlets annulate, glabrous, about 1 cm in diameter. Leaves alternate, somewhat crowded at the tips of the branchlets, oblongo-elliptic to oblong-obovate, 20 to 35 cm long, 9 to 13 cm wide, firmly chartaceous to subcoriaceous, light brown, entire, glabrous above, pubescent with soft, scattered, white, short hairs beneath, acuminate, the acumen 1.5 to 3 cm long, base narrowly rounded to subcordate, lateral nerves 18 to 21 on each side of the midrib, very prominent, reticulations distinct; petioles glabrous, 2.5 to 4 cm long; stipules linear-lanceolate, chartaceous, flaccid, persistent, 5 to 10 cm long, glabrous. Receptacles crowded in the upper axils, sessile, solitary or in pairs, ovoid, 3 to 3.3 cm long, 2 to 2.5 cm in diameter, slightly umbonate, smooth, glabrous, reddish brown; basal bracts 3, ovate, acute. Fertile female flowers few, subsessile, the pedicels 0.25 to 0.5 mm in length; the perianth deeply 4-cleft; achene ovoid-elliptic, about 1.25 mm in diameter; style shorter than the achene; stigma elongate. Gall flowers numerous, the perianth deeply 3-cleft; achene ovoid, smooth; style slightly shorter than the achene, the pedicels 2 to 3 mm in length. Stamen 1, anther oblong, about 1.5 mm long, filament 2.5 to 4 mm long.

BALABAC, *Bur. Sci. 49863 Ramos and Edaño,* December 1, 1927, a strangling fig, apparently assuming the tree form at maturity, in forests along streams at low altitudes.

A species apparently belonging in the group with *Ficus bracteata* Wall. distinguished by its oblong-elliptic to oblong-obovate, acuminate, many-nerved leaves, persistent, long, linear-lanceolate, glabrous stipules, and ovoid, glabrous receptacles. Its annulate branchlets, and the general form of the leaves, except the bases, and the nature of male flowers, suggest *Ficus annulata* Blume, but it differs from Blume's species by its crowded sessile receptacles and persistent stipules.

FICUS CHRYSOCARPA Reinw.

Ficus chrysocarpa REINW. in Blume Bijdr. (1825) 475; MIQUEL, Fl. Ind. Bat. 1[2] (1858–59) 302; Ann. Mus. Bot. Ludg.-Bat. 3 (1867) 270; KING in Ann. Bot. Gard. Calcutta 2 (1888) 151, *t. 191;* HOOK. f., Fl. Brit. Ind. 5 (1890) 531; RIDLEY, Fl. Malay Peninsula 3 (1924) 348.

BALABAC, Mount Apadapad, *Bur. Sci. 49913 Ramos and Edaño,* November 28, 1927, in damp forests near streams, at low altitudes, the identification by E. D. Merrill. New to the Philippines. Indo-China, Malay Peninsula, Sumatra, Java, Borneo.

FICUS PARIETALIS Blume.

Ficus parietalis BLUME, Bijdr. (1825) 462; MIQ., Fl. Ind. Bat.1[2] (1858–59) 307; Ann. Mus. Bot. Ludg.-Bat. 3 (1867) 277; KING in Ann. Bot. Gard. Calcutta 1 (1887) 10, *t. 8;* HOOK. f., Fl. Brit. Ind. 5 (1890) 498; RIDLEY, Fl. Malay Peninsula 3 (1923) 330.

BALABAC, Katakupan, *Bur. Sci. 49734 Ramos and Edaño,* November 26, 1927, on tree trunks in damp forests near streams at low altitudes, the identification by E. D. Merrill. A species here reported from the Philippines for the first time. Malay Peninsula, Sumatra, Java, Amboina.

URTICACEÆ

Genus LAPORTEA Gaudichaud

LAPORTEA STENOPHYLLA sp. nov. Text fig. 1.

Arbor circiter 5 m alta, inflorescentiis et stipulis et ramulis exceptis glabra; foliis chartaceis, anguste-lanceolatis, 10.5 ad 22 cm longis, 1.7 ad 3.5 cm latis, utrinque attenuatis, margine obscure crenulato, nervis lateralibus utrinque 12 ad 16, perspicuis, adscendentibus; paniculis ♂ axillaribus, laxis, angustis, 17 ad 19 cm longis; floribus sessilibus vel subsessilibus, paucis, 4-meris.

A small tree about 5 m high, glabrous except the pubescent inflorescence, stipules, ultimate branchlets, and the younger

petioles. Branches slender, the ultimate ones about 5 mm in diameter. Leaves narrowly lanceolate, chartaceous, 10.5 to 22 cm long, 1.7 to 3.5 cm wide, rarely up to 5 cm wide, olivaceous-brown above, brown beneath when dry, narrowed at both ends, apex slenderly acuminate, base acute, the lower surface minutely white-punctulate, margin shallowly crenulate; lateral nerves 12 to 16 on each side of the midrib, prominent, ascending, ending very close to the margin, the lower ones rather long and ascending; petioles 2.5 to 6 cm long; stipules ovate-lanceolate, 1 to 1.3 cm long, densely ciliate. Staminate panicles axillary, very few, lax, narrow, 17 to 19 cm long, minutely ciliate. Flowers white, few, sessile or subsessile, fascicled, the bracteoles minutely ciliate, oblongo-lanceolate to lanceolate, 0.75 to 1 mm in length, the bracts similar but larger, about 2 mm in length; perianth minutely ciliate outside, obovate, about 2.5 mm

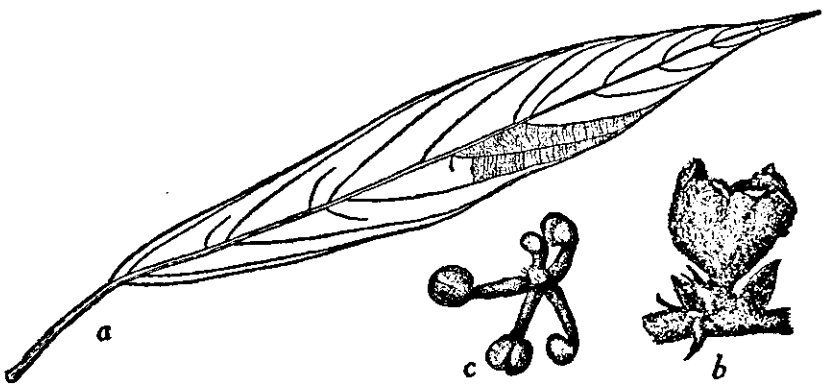


FIG. 1. *Laportea stenophylla* sp. nov.: *a*, a leaf, × 0.5; *b*, a flower showing perianth, bract, and bracteoles, × 6.5; *c*, stamens, and rudimentary ovary, × 6.5.

long, the lobes 4, ovate, 1 mm long; filaments glabrous, 1 to 1.25 mm long; rudimentary ovary minutely ciliate at the base. Pistillate flowers not seen.

MINDANAO, Davao Province, Mount Mayo, *Bur. Sci. 49412 Ramos and Edaño*, April 20, 1927, in damp forests along streams, altitude about 1,000 meters.

A species somewhat suggesting *Laportea anacardioides* C. B. Rob. of which only pistillate specimens are known, differing in its narrowly lanceolate, attenuate, few-nerved, shallowly crenulate leaves, and its pubescent branchlets, stipules, and inflorescences.

ELATOSTEMA BRUNONIANUM sp. nov. Text fig. 2.

Herba dioica, infra prostrata, caulibus erectis vel adscendentibus, usque ad 32 cm longis, gracilibus, ad apicem dense et bre-

vissime adpresse hirsutis, ramis paucis; foliis subsessilibus, membranaceis, oblique lanceolatis, 18 ad 40 mm longis, 5 ad 11 mm latis, subtus brevissime adpresse hirsutis, supra glabris et cystolithis numerosis instructis, acuminatis, basi valde inaequilateralibus, uno latere auriculato altero acuto, margine pro rata grosse dentato, dentibus utrinque 7, perspicuis; receptaculis ♀ axillaribus, sessilibus, solitariis; bracteis exterioribus chartaceis, orbiculare-ovatis, acuminatis, obscure corniculatis, circiter 4 mm longis latisque, interioribus membranaceis, oblanceolatis, apice

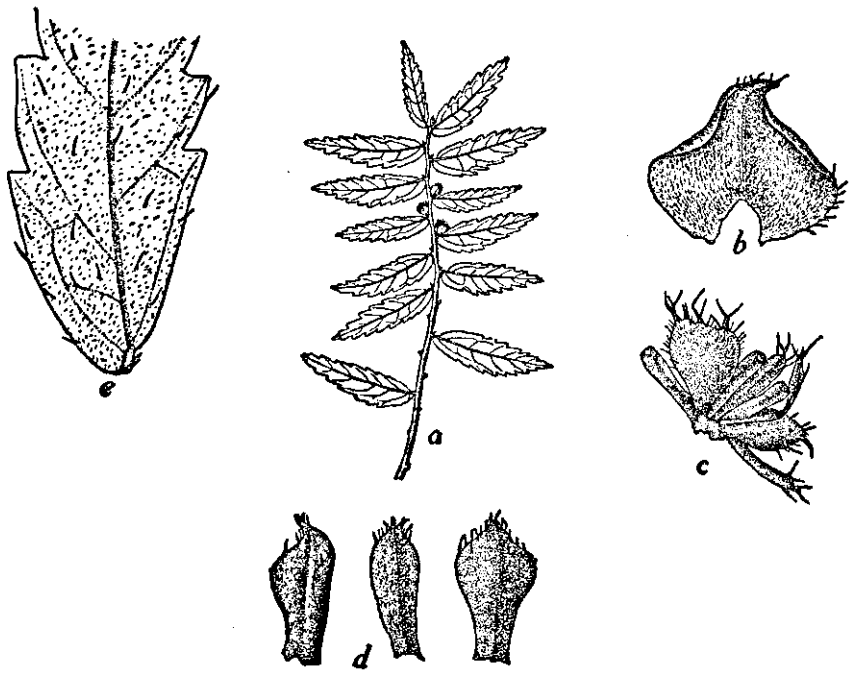


FIG. 2. *Elatostema brunonianum* sp. nov.: *a*, fruiting stem, × 0.5; *b*, fused outer bracts, × 6.5; *c*, achene, perianth lobes, one of the inner bracts and bracteoles, × 6.5; *d*, inner bracts, × 6.5; *e*, base of leaf, upper surface, × 3.25.

ciliatis; perianthi segmentis 3 vel 4; acheniis obovoideis, circiter 2.25 mm longis, 1.5 mm diametro, 3-appendiculatis.

A sparingly branched slender herb, prostrate below, stem ascending or erect, up to 32 cm long, hirsute with short, appressed hairs. Leaves subsessile, membranaceous, obliquely lanceolate, 18 to 40 mm long, 5 to 11 mm wide, acuminate, the base very inequilateral, the broader side with a rounded auricle, the narrower one acute, margins distinctly serrate, the teeth acute, conspicuous, 7 on each side, up to 2.5 mm in length, apex acute to subobtuse, olivaceous-brown, appressed hirsute with very

short hairs beneath, darker and supplied with numerous minute cystoliths above; lateral nerves 4 or 5 on each side of the midrib, rather obscure, anastomosing, reticulations lax; petioles up to 1.5 mm in length; stipules triangular-acute, 1 to 2 mm long. Pistillate receptacles sessile, axillary, solitary, up to 4 mm in diameter; outer bracts fused, chartaceous, orbicular-ovate, about 4 mm long and wide, obscurely corniculate, ciliolate; next inner bracts membranaceous, oblanceolate, acuminate, about 3 mm long, 0.75 to 1 mm wide at the widest portion, ciliate at the apex; bracteoles narrowly linear, about 2 mm long, 0.25 mm wide, ciliate at the apex. Flowers sessile, the perianth lobes 3 or 4, narrowly linear, about 1 mm long, 0.25 mm wide, glabrous; acheme obovoid, about 2.25 mm long, 1.5 mm in diameter, the apex 3-appendiculate, the appendages ciliate.

MINDANAO, Davao Province, Mount Mayo, *Bur. Sci. 49401 Ramos and Edaño*, May 19, 1927, on tree trunks along streams in the mossy forests, altitude about 1,300 meters.

A species probably belonging in the group with *Elatostema catanduanense* Merr., characterized by its conspicuously serrate obliquely lanceolate leaves, its orbicular-ovate, chartaceous, fused outer bracts, and its appendiculate achenes. The species is dedicated to Dr. W. H. Brown, director of the Bureau of Science, Manila.

ELATOSTEMA IRIDENSE sp. nov. Text fig. 3.

Herba dioica, caulibus deorsum prostratis, pubescentibus, parce ramosis; foliis sessilibus, vel rariter subsessilibus, membranaceis, oblanceolatis, 10 ad 20 mm longis 3 ad 5.5 mm latis, subtus dense hispidulosis, supra obscure parce hispidulosis, cystolithis numerosis instructis, apice acutis, basi attenuatis, inaequilateralibus uno latere anguste rotundato altero acuto, margine serrato; receptaculis ♀ sessilibus, solitariis, usque ad 3 mm diametro; bracteis glabris.

Stems sparingly branched, prostrate below, 6 to 19 cm long, the younger ones densely pubescent with short bristlelike hairs, slender, 0.5 to 1.5 mm in diameter. Leaves alternate, sessile, very rarely subsessile, membranaceous, oblanceolate, 10 to 20 mm long, 3 to 5.5 mm wide, apex acute, base narrowed, inequilateral, narrowly rounded on one side, acute on the other, margins except the base with conspicuous rather short teeth, very acute often shortly penicillate teeth, 8 to 12 on each side or fewer on smaller leaves, the terminal one acute, only 1 mm in length, the lower surface light gray-brown, densely hispidulous, the

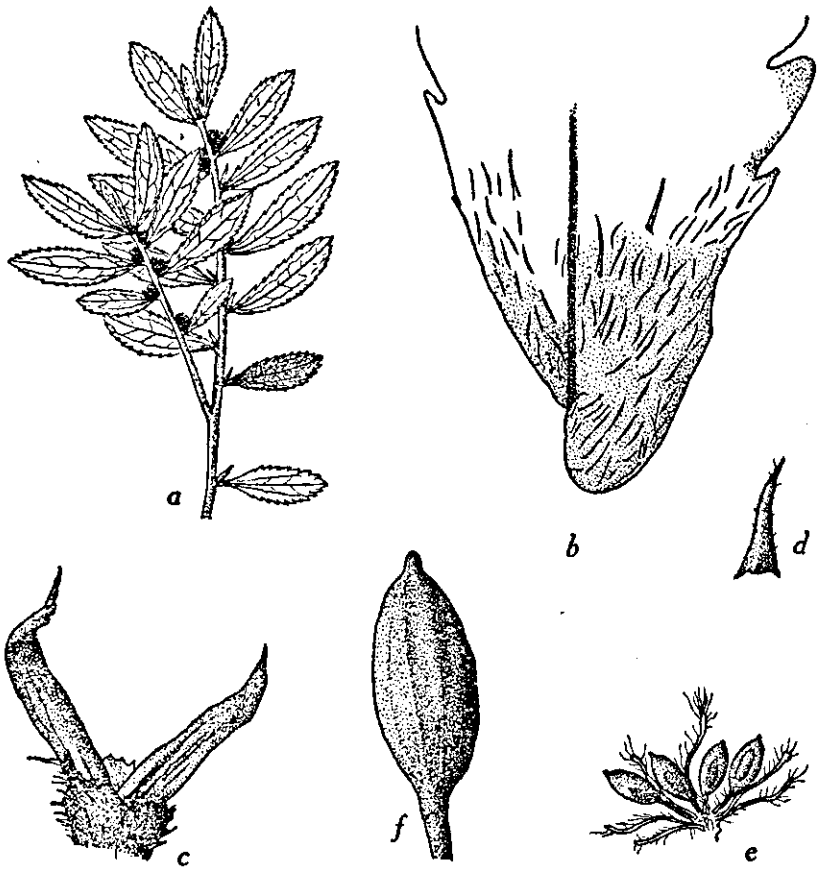


FIG. 3. *Elatostema iridense* sp. nov.: *a*, fruiting branch, natural size; *b*, base of leaf, upper surface, × 13; *c*, pair of outer bracts, × 13; *d*, inner bract, × 13; *e*, bracteoles and achenes, × 13; *f*, achene, greatly enlarged.

upper surface darker, sparsely hispidulous and supplied with numerous cystoliths; lateral nerves delicate, rather obscure, ascending, anastomosing, 4 to 6 on each side of the midrib; stipules linear-lanceolate, about 2 mm in length. Pistillate receptacles axillary, sessile, solitary, 2 to 3 mm in diameter, the outer pair of bracts free, pellucid, linear-lanceolate, acute, about 2 mm in length, glabrous, the inner bracts triangular-lanceolate, acute, about 1.5 mm in length, ciliate outside, the bracteoles narrowly linear, 0.75 to 1.25 mm in length, ciliate; flowers pedicelled, the pedicels filiform, 0.25 to 0.5 mm long, the perianth lobes 3, narrowly linear, about 0.75 mm long; achene ellipsoid, about 0.5 mm long, with longitudinal striations, stigma penicillate. Staminate receptacles not seen.

LUZON, Rizal Province, Mount Irid, *Bur. Sci. 48515 Ramos and Edaño,* November 14, 1926, on rocks on damp forested slopes, altitude about 700 meters.

The alliance of this species is with *Elatostema acrophilum* C. B. Rob., from which it is distinguished by its oblanceolate pubescent leaves which are narrowly rounded on one side rather than auriculate, its numerous acute teeth, and by its bracts and bracteoles.

ARISTOLOCHIACEÆ

Genus THOTTEA Rottboell

THOTTEA PHILIPPINENSIS sp. nov. Plate 2.

Suffrutex simplex, erectus, circiter 0.5 m altus, caulis teretibus, pubescentibus, 5 ad 7 mm diametro; foliis coriaceis, oblongo-ellipticis ad oblongo-lanceolatis, 16 ad 26 cm longis, 4 ad 9 cm latis, acutis vel obscure acute acuminatis, basi rotundatis, supra pallidis, glabris, subtus crebre reticulato-venosis, ad nervis reticulisque dense pallide pubescentibus, breviter petiolatis, petiolo 4 vel 5 mm longo; racemis basilaribus, paucis, usque ad 5 cm longis; floribus pedicellatis, 10 ad 13 mm diametro, hirsutis, alabastris 3-angulatis, obovoideis, post anthesin campanulatis, lobis late ovatis, 6 ad 7 mm longis; staminibus 22.

A small erect undershrub, normally unbranched, up to 0.5 m high; the stem terete, cinereous-pubescent, 5 to 7 mm in diameter, the ultimate parts more or less slender, angled. Leaves coriaceous, oblong-elliptic to oblong-lanceolate, 16 to 26 cm long, 4 to 9 cm wide, apex narrowed, acute, or obscurely and acutely acuminate, base rounded, 3-nerved, glabrous, pale above, densely pubescent with short, cinereous-white, soft hairs beneath, on the midrib, nerves, and close prominent reticulations; lateral nerves 11 to 13 on each side of the midrib including the basal nerves, very prominent, ascending; petioles densely pubescent, 4 to 5 mm long. Racemes basal, simple, few-flowered, up to 5 cm long, the rachis slender, densely pubescent. Flowers odorous, pedicelled, light bluish purple, the pedicels very slender, 0.8 to 1.3 cm long; perianth 1 to 1.3 cm in diameter, in bud 3-angled, obovoid, after anthesis campanulate, the lobes spreading, broadly ovate, reticulate, 6 to 7 mm long. Stamens 10 in the upper row, 12 in the basal row, free.

MINDANAO, Lanao Province, Santo Cogon, *For. Bur. 30249 Roque,* April 22, 1926, in dipterocarp forests, altitude about 150 meters, known locally as *taguibunon* (Lan.).

The genus is new to the Philippines. The habit and the very conspicuous pubescent reticulations on the lower surface of the

leaves suggest *Bragantia affinis* Planch. This well-marked species may be placed near *Thottea tricornis* Maingay, of the Malay Peninsula, from which it differs in its flower characters.

ANONACEÆ

Genus PAPUALTHIA Diels

PAPUALTHIA LONGIPES sp. nov. Text fig. 4.

Species *P. reticulatae* (Elm.) Merr. similis et affinis, differt pedicellis longioribus, 13.5 ad 16.5 cm longis, floribus majoribus, 2 ad 2.5 cm longis.

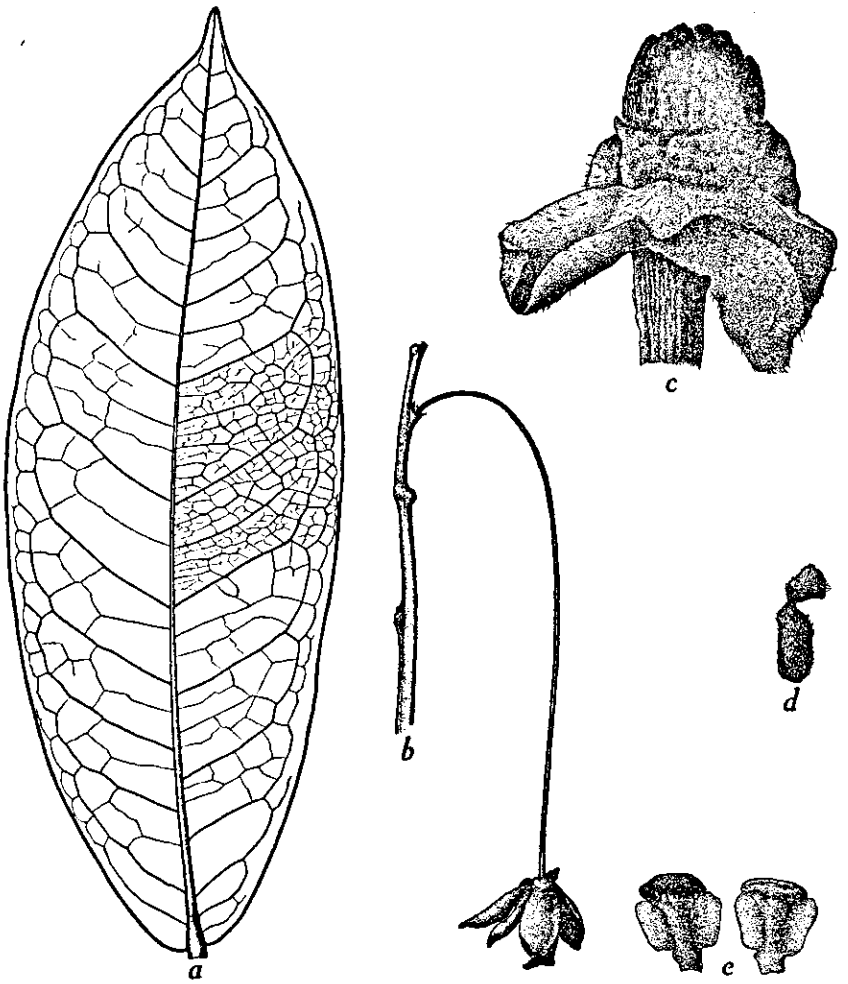


FIG. 4. *Papualthia longipes* sp. nov.: *a*, a leaf, × 0.5; *b*, a flower, × 0.5, *c*, detail of a flower with the petals removed showing sepals, region of attachment of the stamens and carpels, × 6.5; *d*, carpel, × 6.5; *e*, stamens, × 6.5.

An erect shrub about 1 m high, glabrous throughout except the very sparingly pubescent flowers, the stem slender, pale, somewhat angled, about 5 mm in diameter, the tips dark-brown when dry, lenticellate. Leaves chartaceous to subcoriaceous, glabrous, olivaceous-brown above, pale brown beneath when dry, oblong-elliptic to oblong-oblanceolate, 22 to 31 cm long, 6.5 to 12 cm wide, acutely acuminate, base rounded, slightly cordate and inequilateral; primary nerves 12 to 14 on each side of the midrib, prominent, spreading, anastomosing, the secondary ones often about as prominent, the reticulations distinct, lax; petioles 3 to 4 mm long. Flowers axillary, solitary, reddish-brown when dry, the pedicels very long and slender, not thickened upward, 13.5 to 16.5 cm long, glabrous; sepals triangular-ovate, acute or slightly acuminate, about 4 mm long, pubescent; petals, subequal, oblong-ovate or subspathulate, acute or obtuse, coriaceous, sparingly pubescent, the lobes 15 to 18 mm long, 7 to 10 mm wide, the tube 5 to 7 mm long; anthers 1.25 to 1.5 mm long; carpels 19 to 21, oblong, appressed pubescent; stigma obovoid.

LUZON, Tayabas Province, Casiguran (Cabulig River), *Bur. Sci. 45281 Ramos and Edaño,* May 28, 1925, in damp forests at low altitudes.

A species with vegetative characters similar to *Papualthia reticulata* (Elm.) Merr., but with longer pedicels and larger flowers.

LEGUMINOSÆ

Genus DERRIS Loureiro

DERRIS FERRUGINOIDES sp. nov. § Euderris. Plate 3 and text fig. 5.

Frutex scandens, dense ferrugineo-pubescens; foliolis 7, subcoriaceis, oblongis, oblongo-ellipticis, vel oblongo-obovatis, 4.5 ad 11 cm longis, 2.5 ad 5.2 cm latis, in siccitate supra nitidis, olivaceo-viridibus, glabris, subtus pallide brunneis, dense ferrugineo-pubescentibus, apice breviter obtuseque acuminatis, base obtusis ad rotundatis; paniculis multifloris, terminalibus axillaribusque, 14 ad 17 cm longis; floribus albis, fasciculatis, 10 ad 12 mm longis; calycibus dense pubescentibus, circiter 4 mm longis; petalis extus pubescentibus; staminibus glabris; leguminibus planis suborbicularibus ad subellipticis, compressis, 2.5 ad 3.5 cm longis, 2 ad 2.5 cm latis.

A scandent vine, the branches terete, reddish brown when dry, densely ferruginous-pubescent, prominently lenticellate. Leaves pinnate, the common petiole and rachis 8.5 to 11 cm long. Leaf-

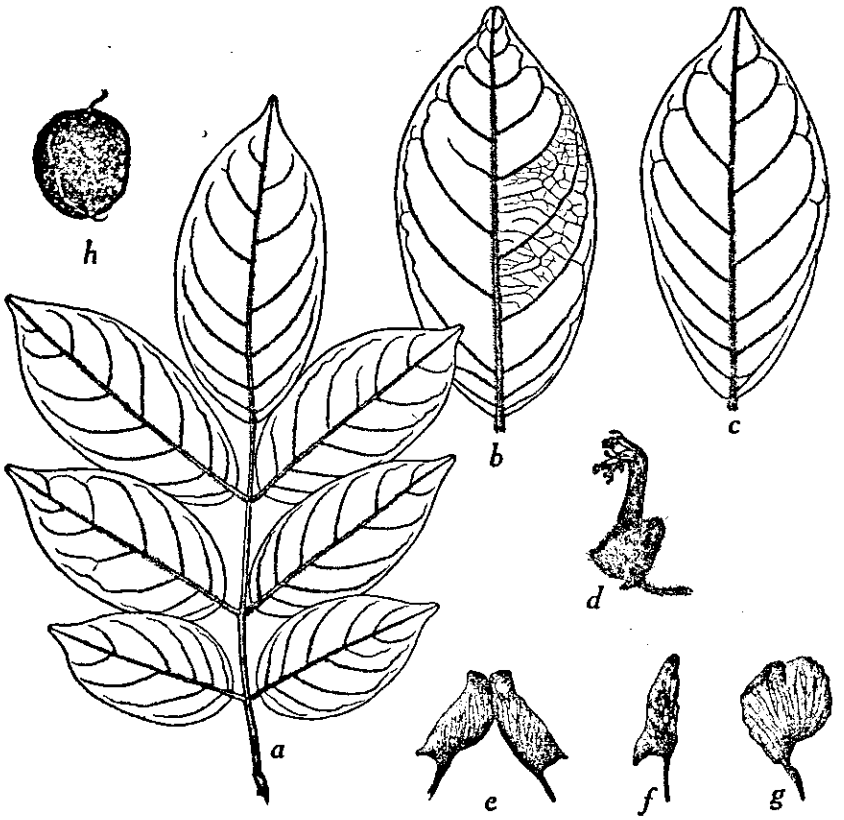


FIG. 5. *Derris ferruginoides* sp. nov.: *a*, leaf, × 0.5; *b–c*, leaflets, × 0.5; *d*, flower with petals removed, × 2; *e*, keel, × 2; *f*, wing, × 2; *g*, standard, × 2; *h*, fruit, × 0.5.

lets 7, subcoriaceous, oblong, oblong-elliptic or oblong-obovate, 4.5 to 11 cm long, 2.5 to 5.2 cm wide, olivaceous-green, shining and glabrous above, light brown, densely ferruginous-pubescent beneath, apex shortly and obscurely blunt-acuminate, base obtuse to rounded; lateral nerves darker than the parenchyma, slender, prominent, ascending, anastomosing, 6 to 8 on each side of the midrib; petiolules 3 to 6 mm long. Panicles many-flowered, terminal and in the upper axils, 14 to 17 cm long, the branches up to 5 cm long. Flowers fascicled, 10 to 12 mm long; the pedicels slender, 3 to 4 mm long; calyx ferruginous-pubescent, cup-shaped, about 4 mm long, faintly or broadly toothed, the teeth unequal, obtuse or rounded, and up to 0.75 mm in length; standard about 10 mm long, the claw 3.5 mm long, the lamina suborbicular, retuse, pubescent outside, wings

adherent to the keel, their claws very slender, about 3 mm in length, their blades lanceolate, about 7.5 mm long, with a basal appendage; stamens glabrous; ovary densely pubescent. Pods thin, flat, densely ferruginous-pubescent, suborbicular to subelliptic, 2.5 to 3.5 cm long, 2 to 2.5 cm wide, the base rounded, apex distinctly apiculate, the apiculum 5 to 7 mm in length, the wings thin, the upper prominent, 4 to 7 mm wide, the lower 2 to 3 mm wide. Seeds not seen.

LUZON, Isabela Province, Santiago, *Clemens 7406a*, April, 1926 (type in the herbarium of the University of California), in thickets and second-growth forests; Ilagan to San Mariano, *Clemens 7406b*, April, 1926.

A species allied to *Derris ferruginea* Benth., differing especially in its densely pubescent suborbicular to subelliptic pods, its white flowers, its shorter flower pedicels, and other minor characters.

MELIACÆ

Genus AGLAIA Loureiro

AGLAIA RAMOSII sp. nov. § Euaglaia. Text fig. 6.

Arbor parva, ramulis et subtus foliolis et inflorescentiis desissime cupreo-lepidotis; foliolis 6 vel 7, alternis vel oppositis, firmiter chartaceis ad subcoriaceis, oblongo-ellipticis ad oblongo-obovatis, 7.5 ad 12.5 cm longis, 4.5 ad 5.5 cm latis, acute cuspidatis vel acuminatis, basi inaequilateralibus; paniculis folia subaequantibus, multifloris; floribus circiter 3 mm diametro, 5- meris, in ramulis ultimis racemose dispositis, pedicellis 2 ad 3.5 mm longis; petalis circiter 2.5 longis, 1 ad 1.5 mm latis; tubo obovoideo, truncato, circiter 1.5 mm longo.

A small tree, the branchlets, inflorescences, rachis of the leaves, and the under surface of the leaflets very densely cupreous-lepidote, shining, the branches terete, somewhat lepidote, brownish. Leaves alternate, 21 to 28 cm long, the petiole and rachis terete, 11.5 to 17.5 cm long; leaflets 6 or 7, alternate or opposite, firmly chartaceous to subcoriaceous, oblong-elliptic to oblong-obovate, 7.5 to 12.5 cm long, 4.5 to 5.5 cm wide, the lower ones ovate-elliptic, rather abruptly acutely acuminate, the base inequilateral, narrowed acute or obscurely decurrent-acuminate, the upper surface olivaceous-green, and with few scattered scales, these more numerous on or near the midrib, shining, the lower surface prominently and very densely cupreous-lepidote, shining; nerves 9 to 11 on each side of the midrib, straight, obscurely anastomosing, the reticulations obsolete;

FIG. 6. *Aglaia ramosii* sp. nov.: *a*, a flowering branch, showing a leaf, and the whole length of a panicle with the branches removed, × 0.5; *b*, a branch of the panicle, × 0.5; *c*, a flower, × 6,5; *d*, hooded and flat petals, × 6.5; *e*, a flower with the petals removed, showing staminal tube and calyx, × 6.5; *f*, longitudinal section of the staminal tube showing stamens , × 6.5; *g*, ovary, × 6.5.

petiolules 1 to 1.5 cm long. Panicles axillary, about as long as the leaves, all parts very densely cupreous-lepidote, shining, many-flowered, the lower primary branches often 16 cm long. Flowers yellow, about 3 mm in diameter, pedicellate, racemosely and laxly disposed on the ultimate branchlets, their pedicels 2 to 3.5 mm long. Calyx densely lepidote, the lobes spreading, unequal, ovate to broadly oblong, about 0.5 mm long; the tube almost as long as the lobes. Petals 5, glabrous, somewhat fleshy, subequal, hooded or flat, oblong, orbicular or oblong-obovate, obtuse, about 2.5 mm long, 1 to 1.5 mm wide. Staminal tube obovoid, about 1.5 mm long, toothed, glabrous except the small teeth which are minutely ciliate outside, free from the petals. Anthers 5, inserted at about the middle of the tube, sessile, inflexed, included, about 0.5 mm in length. Ovary globose.

LUZON, Rizal Province, Mount Irid, *Bur. Sci. 48426 Ramos and Edaño*, November 17, 1926, on damp forested slopes, altitude about 800 meters.

A species apparently allied to *Aglaia denticulata* Turcz., but distinguished by its leaflets which are olivaceous-green above, copper-colored and very densely cupreous-lepidote and puncticulate beneath, its laxly arranged and longer-pedicelled flowers, and its spreading calyx lobes.

EUPHORBIACEÆ

Genus TRIGONOSTEMON Blume

TRIGONOSTEMON FILIFORME sp. nov. § Eutrigonostemon. Text fig. 7.

Frutex partibus junioribus et subtus foliis et inflorescentiis pubescentibus; foliis lanceolatis ad lineari-lanceolatis, 9.5 ad 19.5 cm longis, 1.3 ad 2.8 cm latis, utrinque subaequaliter angustatis, tenuiter acuminatis, basi plerumque cuneatis, nervis utrinque 10 ad 14; inflorescentiis ♀ et ♂ plerumque simplicibus, filiformibus, laxis, axillaribus, usque ad 13 cm longis; floribus ♀ paucis, pedicellatis, bracteis foliaceis, lanceolatis, 3 ad 6 mm longis; sepalis eglandulosis, oblongis ad oblongo-lanceolatis, acutis, 3 ad 4 mm longis, extus dense pubescentibus; petalis oblongo-oblanceolatis, obtusis, circiter 4 mm longis, 1.25 ad 1.5 mm latis, glabris; ovario ovoideo, dense pubescente; floribus ♂ minoribus, sepalis obovatis, rotundatis, circiter 1.5 mm longis, 0.5 mm latis; petalis oblongo-obovatis, rotundatis, circiter 2 mm longis, 1.25 mm latis; antheris 3, globosis.

A shrub, the branches terete, 2 to 4 mm in diameter, glabrous, the younger parts densely pubescent. Leaves lanceolate to

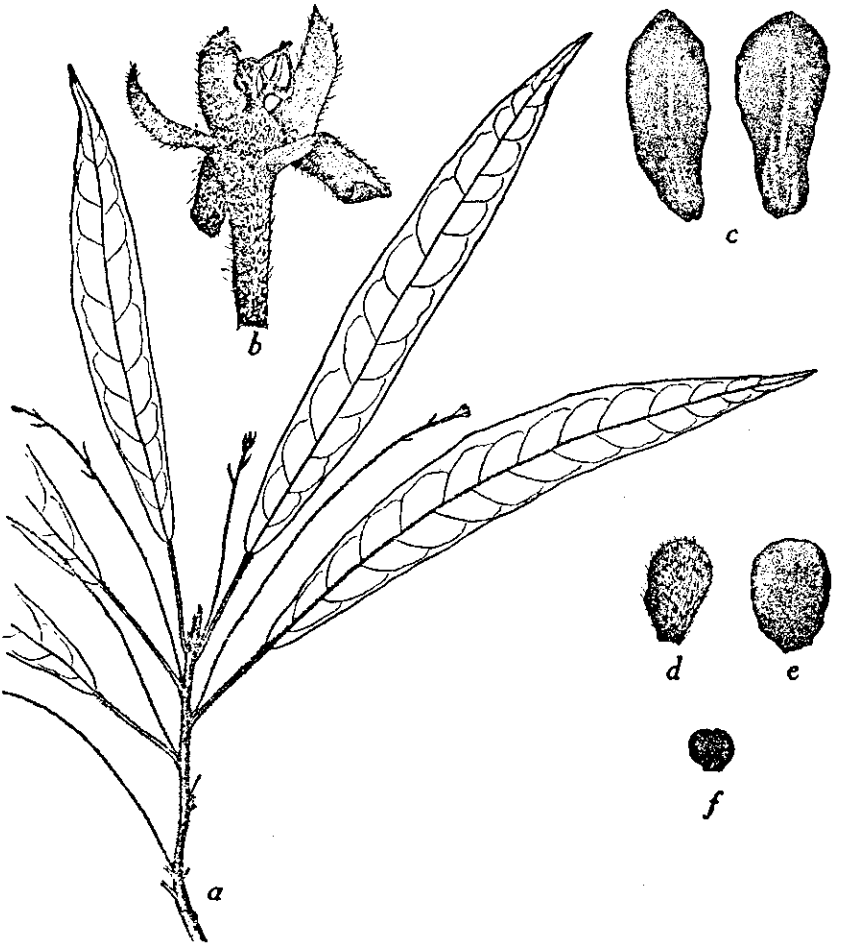


FIG. 7. *Trigonostemon filiforme* sp. nov.: *a*, a flowering branch, × 0.5; *b*, female flower with the petals removed, showing sepals and pistil, × 6.5; *c*, petals of female flower, × 6.5; *d*, sepal of male flower, × 6.5; *e*, petal of male flower, × 6.5; *f*, stamen, × 6.5.

linear-lanceolate, 9.5 to 19.5 cm long, 1.3 to 2.8 cm wide, chartaceous, subequally narrowed to the usually cuneate base and the rather slenderly acuminate apex, the margins obscurely undulate or entire, the upper surface glabrous when mature, pubescent when young, dark olivaceous to almost black when dry, the lower surface paler, softly pubescent beneath; lateral nerves 10 to 14 on each side of the midrib, arched, rather obscure, reticulations often obsolete; petioles 1 to 4.5 cm long, pubescent. Both ♀ and ♂ inflorescences on the same branch,

filiform, lax, simple or depauperate-paniculate, long-peduncled, pubescent, up to 13 cm long, branches very few, never more than three, short, often absent; bracts foliaceous, lanceolate, 3 to 6 mm in length. Female flowers very few, 1 to 3, pedicelled, the pedicels up to 1 cm in length, thickened upward; bracteoles similar to the bracts in form but smaller; sepals eglandular, free, oblong to oblong-lanceolate, acute, 3 to 4 mm long, 0.75 to 1 mm wide, densely pubescent outside; petals purple, oblong-oblanceolate, obtuse, about 4 mm long, 1.25 to 1.5 mm wide, glabrous; ovary ovoid, densely pubescent; styles 3, cleft nearly to the base, the style arms linear, 0.75 to 1 mm long. Male flowers similar to the female in number and arrangement, differing in their obovate, rounded sepals which are about 1.5 mm long, 0.5 mm wide, and its smaller petals which are about 2 mm long and 1.25 mm wide; anthers 3, sessile, erect, globose.

LUZON, Isabela Province, Mount Moises, *Clemens 16751*, April 1926, in forests.

The alliance of this species is doubtless with *Trigonostemon laxiflorus* Merr., from which it differs in the size and form of its leaves, shorter, filiform peduncles, and smaller female flowers.

TRIGONOSTEMON STENOPHYLLUS sp. nov. § Eutrigonostemon. Text fig. 8.

Frutex dioicus circiter 1 m altus, partibus junioribus et subtus foliis plus minusve pubescentibus; foliis chartaceis, integris, lanceolatis, 5.5 ad 16.5 cm longis, 1 ad 2.5 cm latis, utrinque subaequaliter angustatis, apice tenuiter acuminatis, basi cuneatis ad obtusis, nervis utrinque 6 ad 11, obscuris; inflorescentiis ♀ racemosis, tenuibus, axillaribus, usque ad 5.5 cm longis; floribus paucis, longe pedicellatis, pedicellis 1 ad 2 cm longis; bracteis anguste lanceolatis, 3 ad 4 mm longis; sepalis eglandulosis, liberis, lanceolatis ad oblanceolatis, acutis ad obtusis, 4 ad 4.5 mm longis, 1 ad 1.25 mm latis, extus pubescentibus; petalis oblongo-oblanceolatis, rotundatis, circiter 5 mm longis, 2 mm latis, glabris; ovario ovoideo, dense pubescente; stylis 3, partitis; capsulis depresso-globosis, circiter 12 mm diametro, sepalis haud accrescentibus apud fructu, usque ad 4.5 mm longis, 1.25 mm latis.

A shrub about 1 m high, the younger parts pubescent. Branches terete, 2 to 3.5 mm in diameter, glabrous. Leaves chartaceous, lanceolate, 5.5 to 16.5 cm long, 1 to 2.5 cm wide, subequally narrowed to the cuneate or obtuse base and the rather slenderly acuminate apex, the margins entire, the upper surface glabrous, brown to dark brown when dry, the lower surface

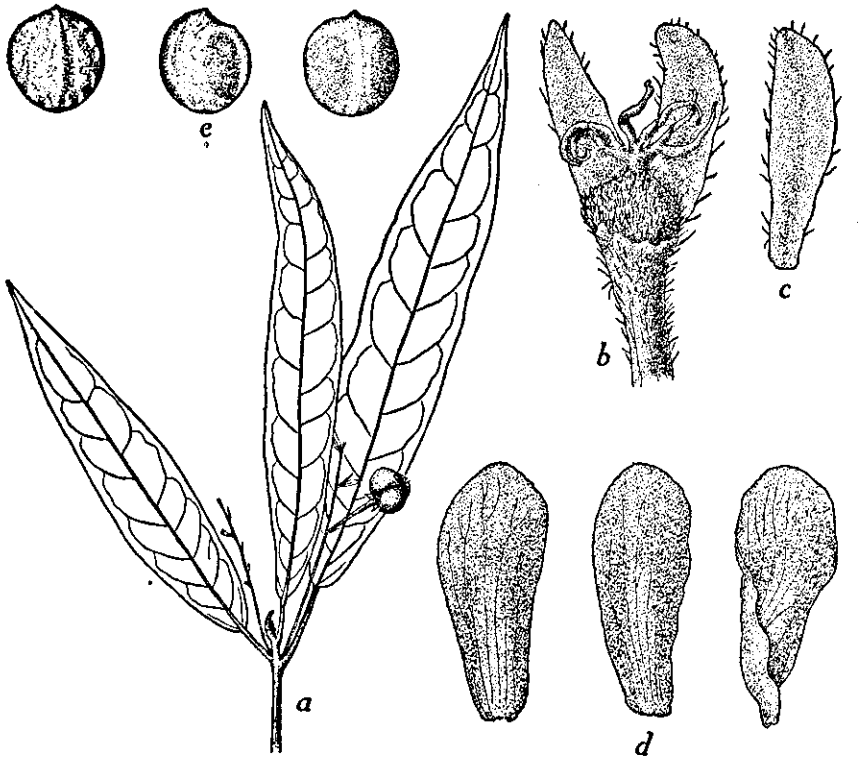


FIG. 8. *Trigonostemon stenophyllus* sp. nov.: *a*, a fruiting branchlet, × 0.5; *b*, female flower showing ovary and two sepals, × 6.5; *c*, a sepal, × 6.5; *d*, petals, × 6.5; *e*, seed in different views, × 2.

paler, somewhat pubescent; lateral nerves 6 to 11 on each side of the midrib, obscure, arched-anastomosing, reticulations lax, not distinct; petioles 1 to 4 cm long, somewhat pubescent. Pistillate inflorescences axillary, very slender, simple, racemose, up to 5.5 cm long, pubescent; bracts narrowly lanceolate, 3 to 4 mm long. Flowers very few, long-pedicelled, the pedicels 1 to 2 cm long, slightly thickened upward; sepals eglandular, free, lanceolate to oblanceolate, acute to obtuse, 3 to 4.5 mm long, 1 to 1.25 mm wide, pubescent outside; petals oblong-oblanceolate, rounded, about 5 mm long, 2 mm wide, glabrous; ovary ovoid, densely pubescent; styles 3, cleft almost to the base, the arms linear, 1.5 to 1.75 mm long. Capsules depressed-globose, about 12 mm in diameter, brown, sparingly pubescent, the sepals not accrescent in fruit, up to 4.5 mm long, 1.25 mm wide. Seeds subglobose, about 5.5 mm in diameter, smooth, shining, reddish brown.

LUZON, Isabela Province, Mount Moises, *Bur. Sci. 47331 Ramos and Edaño,* March 3, 1926, on forested slopes, altitude about 1,000 meters.

A species allied to *Trigonostemon angustifolius* Merr., differing in its densely pubescent ovary, its sepals being decidedly smaller and not accrescent in fruit, in its smaller bracts and flowers and its longer petioles, while the venation is not as prominent.

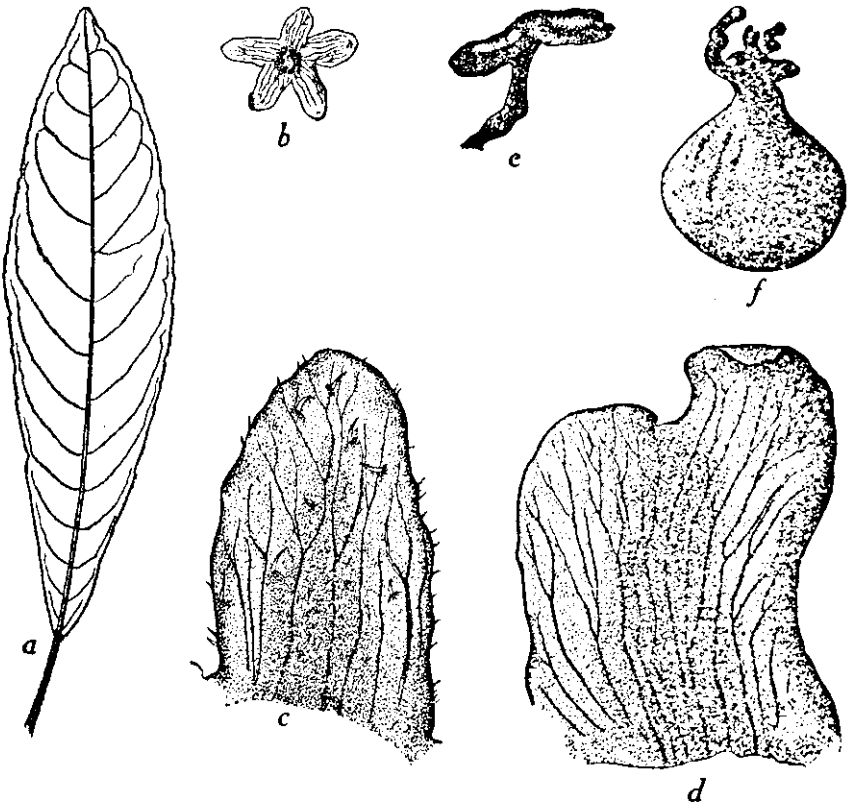


FIG. 9. *Saurauia oblancilimba* sp. nov.: *a*, leaf, × 0.5; *b*, calyx, × 1; *c*, sepal, × 6.5; *d*, petal, × 6.5; *e*, stamen, × 6.5; *f*, pistil, × 6.5.

DILLENIACEÆ

Genus SAURAUIA Willdenow

SAURAUIA OBLANCILIMBA sp. nov. Text fig. 9.

Frutex circiter 4 m altus, ramulis junioribus inflorescentiisque furfuraceis et adpresse breviter setosis; foliis oblanceolatis, 11.5 ad 21 cm longis, 3 ad 4.5 cm latis, subcoriaceis, basi attenuatis,

apice breviter acuminatis, minutissime apiculatis, calloso-serrulatis, utrinque glabris, laevis, nervis utrinque circiter 12, perspicuis; inflorescentiis axillaribus, cymosis, pedunculatis, bracteatis, paucifloris, 3.5 ad 8 cm longis; floribus sparsis, circiter 15 mm diametro, pedicellatis; sepalis subaequalibus, late elliptico-ovatis ad oblongis, obtusis ad rotundatis, 6 ad 7 mm longis, 3.5 ad 5 mm latis, parcissime adpresse-setosis; corollae lobis retusis, circiter 5 mm longis; staminibus circiter 25; ovario globoso-ovoideo; stylis 3, basi unitis.

A shrub about 4 m high, the younger branches and inflorescences furfuraceous and appressed-setose, the setæ short, the young leaves sparingly appressed-setose on both surfaces. Leaves oblanceolate, subcoriaceous, 11.5 to 21 cm long, 3 to 4.5 cm wide, at maturity smooth and glabrous on both surfaces, the upper surface dark-brown, the lower paler when dry, shining on both surfaces, gradually narrowed to the acute base, apex somewhat acuminate, with very minute apiculum, margins callose-serrulate; lateral nerves about 12 on each side of the midrib, prominent, curved-ascending, anastomosing, the reticulations distinct on both surfaces; petioles 1.5 to 2.5 cm long. Inflorescences axillary, cymose, peduncled, 3.5 to 8 cm long. Flowers few, about 1.5 cm in diameter, their pedicels slender, densely appressed-setose, up to 10 mm in length, each with two or three, small, elliptic-ovate, acute bracts, 2 to 6 mm long. Sepals subequal, broadly elliptic-ovate to oblong, obtuse to rounded, 6 to 7 mm long, 3.5 to 5 mm wide, slightly appressed-setose. Petals red, the lobes about 5 mm long, 5 to 6 mm wide, retuse, the lobules subequal, up to 2 mm in length, the tube about 3 mm long. Ovary globose-ovoid; the styles 3, united at the base, the arms about 1.5 mm long. Stamens about 25, filaments 3 to 3.5 mm long.

LUZON, Zambales Province, Mount Tapolao, *Bur. Sci. 44738 Ramos and Edaño,* November 27, 1924, along forested streams, altitude about 900 meters.

A species belonging in the group with *Saurauia papillulosa* Merr., but distinct from it, in that the leaves are not papillulose. It also differs in its oblanceolate, glabrous, callose-serrulate leaves, its sepals, in the number of its stamens, and the number and nature of its styles.

SAURAUIA TAYABENSIS sp. nov. Text fig. 10.

Frutex 1 ad 3 m altus, glaber vel inflorescentiis parcissime furfuraceis; foliis oblongis ad oblongo-oblanceolatis, 7 ad 16.5 cm

longis, 2 ad 4.5 cm latis, subcoriaceis ad coriaceis, base attenuatis, apice acute acuminatis, utrinque glabris nitidisque, nervis utrinque 5 ad 8, distantibus, tenuibus, obscuris, reticulis obsoletis; cymis axillaribus, pedunculatis, usque ad 9 cm longis; floribus paucis, circiter 1.2 cm diametro; sepalis oblongis ad suborbicularibus, rotundatis, 5 ad 7 mm longis; corrollae lobis oblongis, subretusis, 5 ad 6 mm longis, 5 ad 6 mm latis, tubo 3 ad 3.5 mm longo. Ovario glabro, depresse-globoso; stylis 3, basi unitis; staminibus circiter 20.

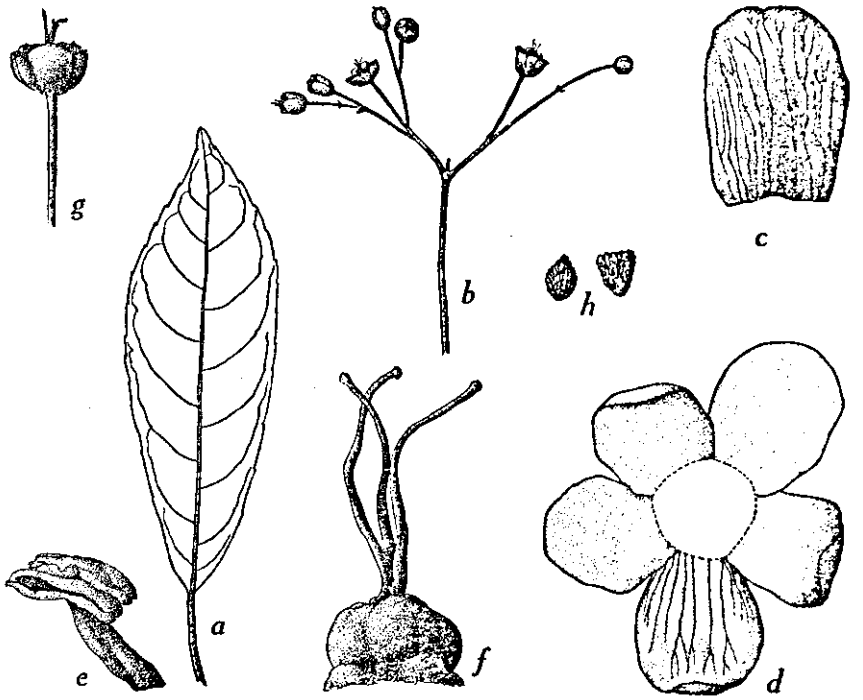


FIG. 10. *Saurauia tayabensis* sp. nov.; *a*, leaf, × 0.5; *b*, cyme, × 0.5; *c*, petal, × 3.25; *d*, calyx, × 3.25; *e*, stamen, × 6.5; *f*, pistil, × 6.5; *g*, fruit, × 1; *h*, seeds, x 6.5.

A shrub 1 to 3 m high, the inflorescences and the younger branchlets usually with few, scattered, ovate or orbicular, closely appressed scales, otherwise glabrous, except the ciliate margins of the sepals. Leaves oblong to oblong-oblanceolate, 7 to 16.5 cm long, 2 to 4.5 cm wide, subcoriaceous to coriaceous, smooth and glabrous on both surfaces, the upper surface reddish brown to brown, the lower paler when dry, shining on both surfaces, acutely acuminate, narrowed to the cuneate or acute base, the

margins distantly callose-serrulate; lateral nerves 5 to 8 on each side of the midrib, distant, curved-ascending, obscurely anastomosing, slender and obscure on the lower surface, the reticulations obsolete; petioles 1.5 to 4 cm long. Inflorescences axillary, cymose, peduncled, 3 to 9 cm long. Flowers few, white, about 1.2 cm in diameter, their pedicels slender, up to 15 mm long, the bracts linear-lanceolate, 3 to 4 mm long. Sepals subequal, oblong to suborbicular, rounded, 5 to 7 mm long, 4.5 to 5 mm wide, the margins ciliate, otherwise glabrous. Corolla lobes oblong, subretuse, 5 to 6 mm long, 5 to 6 mm wide, the tube 3 to 3.5 mm long. Ovary glabrous, depressed-globose; styles 3, united at the base, the arms 3.5 to 4 mm long. Stamens about 20. Fruits depressed-globose, about 0.8 cm in diameter, their pedicels 1.5 to 1.8 cm in length. Seeds minute, reddish- brown, ovoid, ellipsoid or triangular-ovoid, 0.75 to 1 mm long.

LUZON, Tayabas Province, Mount Alzapan, *Bur. Sci. 45701 Ramos and Edaño* (type), June 7, 1925, in the mossy forest, altitude about 2,000 meters; Casiguran, *Bur. Sci. 45252 Ramos and Edaño,* May 2, 1925, along forested streams, at low altitudes.

A species in its inflorescence and the form of its sepals similar to *Saurauia polysperma* (Blanco) Merr., but otherwise not closely allied to that species. It appears to be close to *Saurauia glabrifolia* Merr., but differs in its cymose, peduncled inflorescences, its smaller leaves and flowers, in the form of its sepals, and in its styles being united at the base.

SAURAUIA TRICHOPHORA sp. nov. Text fig. 11.

Frutex 2 ad 3 m altus, ramulis inflorescentiisque perspicue longe ciliato-setosis; foliis oblongis ad oblongo-oblanceolatis, 5 ad 14.5 cm longis, 2 ad 4.5 cm latis, chartaceis, supra rubro-brunneis, subtus brunneis, tenuiter caudato-acuminatis, basi obtusis ad rotundatis, margine serrato, dentibus longe setosis, nervis utrinque 10 ad 14, perspicuis; inflorescentiis axillaribus, pedunculatis, cymosis, paucifloris, usque ad 5.5 cm longis, bracteatis; bracteis ovatis ad lanceolatis, 6 ad 12 mm longis, acuminatis, setosis; sepalis inaequalibus, oblongo-ovatis, 4 ad 5 mm longis, extus longe setosis; corollæ lobis oblongis, 7 ad 8 mm longis, inaequilateraliter retusis; ovario glabro, stylis 3; staminibus circiter 20.

A shrub 2 to 3 meters high, the branchlets, petioles, inflorescences, and leaves conspicuously setose-ciliate with slender, spreading brownish hairs 2 to 10 mm in length, the older branches glabrous, terete, pale brown, the younger branchlets

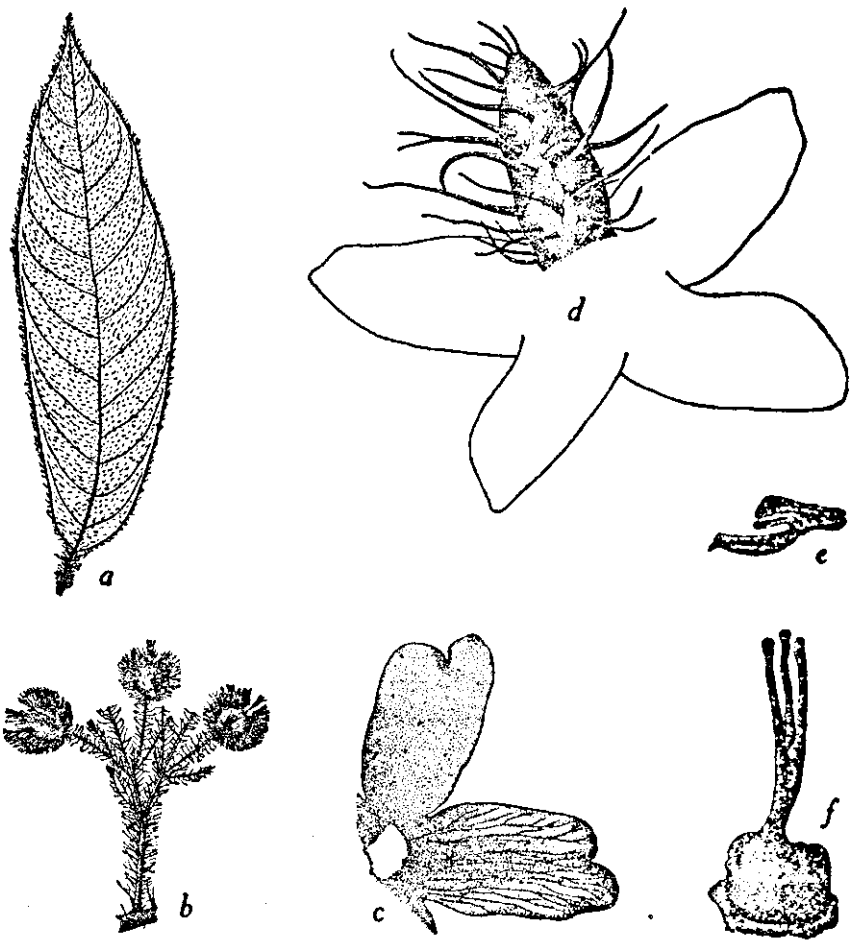


FIG. 11. *Saurauia trichophora* sp. nov.; *a*, leaf, upper surface, × 0.5; *b*, cyme, × 1; *c*, corolla showing two of the petals, × 3.25; *d*, calyx showing hairs on one sepal, × 6.5; *e*, stamen, × 6.5; *f*, pistil × 6.5.

1.5 to 2 mm in diameter. Leaves chartaceous, oblong to oblong-oblanceolate, 5 to 14.5 cm long, 2 to 4.5 cm wide, narrowed above to the slenderly caudate-acuminate apex, the base obtuse or rounded, margins serrate, the teeth tipped with long setæ, conspicuously setose-ciliate on both surfaces, the upper surface reddish brown, the lower brown; lateral nerves 10 to 14 on each side of the midrib, prominent on the lower surface, ascending; petioles long-setose, 10 to 20 mm long. Cymes axillary, peduncled, few-flowered, 2.5 to 5.5 cm long, the bracts foliaceous, setose-ciliate, ovate to lanceolate, acuminate, 6 to 12 mm long.

Flowers about 1.2 cm in diameter. Sepals unequal, oblong-ovate, 4 to 5 mm long, 1.74 to 3 mm wide, subacute to obtuse, the exterior ones densely long setose in all parts, the interior ones setose only in the median parts. Corolla white, the lobes oblong, 7 to 8 mm long, 4 to 4.5 mm wide, inequilaterally retuse, glabrous, the tube about 1.5 mm long. Ovary glabrous, subglobose; styles 3, united for about one-half their length, the arms about 2 mm long. Stamens about 20, the filaments and anthers about 3 mm long.

LUZON, Tayabas and Nueva Vizcaya Provinces, Mount Alzapan, *Bur. Sci. 45711* (type), *45738 Ramos and Edaño*, May 24, 1925, along streams in damp forests and on forested slopes in the mossy forest, altitude 1,000 to 1,300 meters.

A species closely allied to *Saurauia loheri* Merr., but its leaves conspicuously ciliate-setose on both surfaces, the flowers much smaller, the styles 3, and united about half way to the base, and the ovary glabrous.

Bur. Sci. 45720 Ramos and Edaño, May 20, 1925, from the same locality, probably represents a form of the same species, differing in its much longer setæ, particularly those on the upper surface of the leaves, the inflorescences, and the branchlets.

MYRTACEÆ

Genus EUGENIA Micheli

EUGENIA CASIGURANENSIS sp. nov. § Jambosa. Text fig. 12.

Frutex glaber; ramis teretibus; foliis late elliptico-ovatis, subcoriaceis, 16.5 ad 20.5 cm longis, 9 ad 12.5 cm latis, cuspidatis, basi late acutis, supra brunneis, subtus pallide brunneis, nervis primariis utrinque 10 ad 12, valde perspicuis, juxta marginem distincte anastomosantibus; inflorescentiis terminalibus, circiter 7 cm longis; floribus ante anthesin confertis, obovoideis; fructibus ellipsoideis, umbonatis, nigrescentibus, 2.5 ad 3 cm longis, 1.3 ad 1.5 cm diametro, pedicellis 4 ad 5 mm longis.

A glabrous shrub, about 1 m high; the branches terete, gray, 3.5 to 5 mm in diameter. Leaves broadly elliptic-ovate, 16.5 to 20.5 cm long, 9 to 12.5 cm wide, subcoriaceous, cuspidate, the base broadly ovate, brown above, pale brown beneath, shining on both surfaces; primary lateral nerves 10 to 12 on each side of the midrib, very prominent, anastomosing with the equally prominent marginal nerves, the reticulations lax, distinct; petioles 1.5 to 2 cm long. Cymes terminal, including the

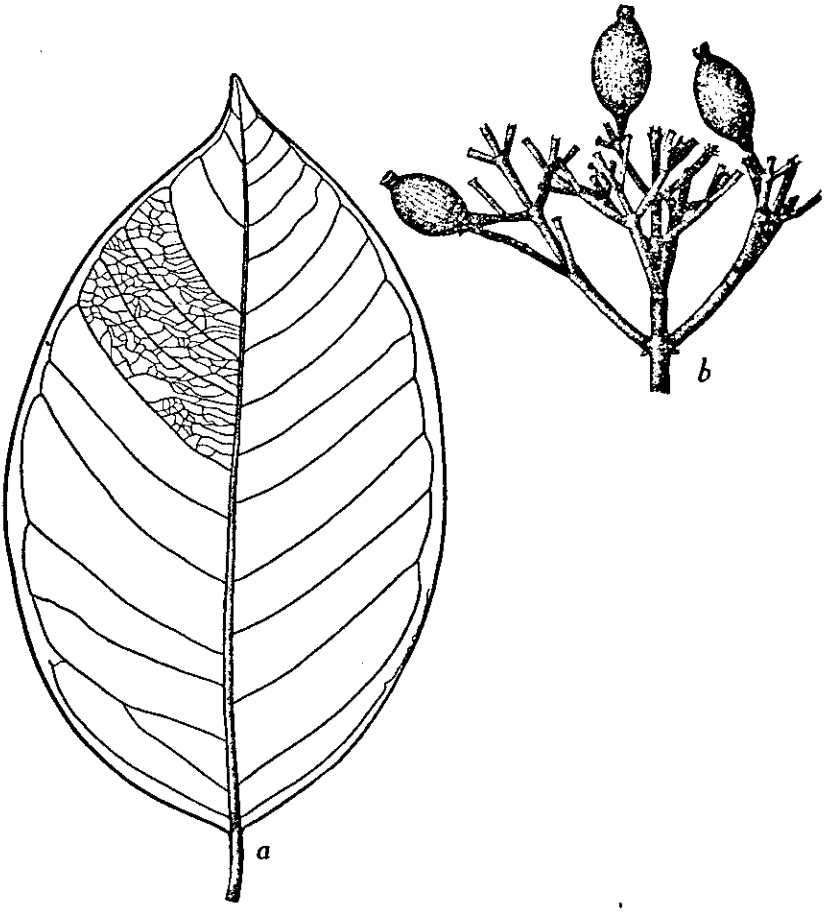


FIG. 12. *Eugenia casiguranensis* sp. nov.; *a*, leaf, × 0.5; *b*, infructescence, × 0.5.

peduncles about 7 cm long, dichotomous or trichotomous, the peduncles 2 to 3.8 cm long; bracts deciduous. Flowers in bud crowded, 4-merous, white, bracteoles cuneate, about 0.75 mm in length. Fruits ellipsoid, umbonate, black, 2.5 to 3 cm long including the umbo, 1.3 to 1.5 cm in diameter, the pedicels 4 to 5 mm long.

LUZON, Tayabas Province, Casiguran, *Bur. Sci. 45464* (type), *45499 Ramos and Edaño*, May 4, 1925, along forest streams, at low altitudes.

A species distinct from any known Philippine form, characterized by its broadly elliptic-ovate, cuspidate leaves and its ellipsoid, umbonate fruits.

EUGENIA ELLIPTILIMBA Merr.

Eugenia elliptilimba MERR. in Journ. Str. Branch Roy. As. Soc. 77 (1917) 211; Enum. Philip. Fl. Pl. 3 (1923) 165.

The type of this species, which was based on flowering specimens, is Bornean. The Mindanao fruiting material cited below and determined by E. D. Merrill, doubtless represents this species.

Fruits globose, about 2 cm in diameter (mature), dark brown, glandular, the pedicels 1 to 2 mm in length.

MINDANAO, Zamboanga Province, Mount Tubuan, *Bur. Sci. 36604, 36605, 36638 Ramos and Edaño,* October 30, 1919, in forests at low altitudes, ascending to 500 meters. Borneo.

EUGENIA ISABELENSIS sp. nov. Text fig. 13.

Frutex glaber, 1 ad 2 m altus; ramis ramulisque teretibus; foliis coriaceis, ellipticis ad late oblongo-ellipticis, 22 ad 33 cm longis, 7.5 ad 12 cm latis, apice caudatis ad tenuiter acuminatis, basi late acutis, in siccitate supra brunneis, subtus pallidis, nitidis, nervis primariis utrinque 16 ad 18, distinctis, juxta marginem distincte anastomosantibus, reticulis obscuris ad obsoletis; infructescentiis terminalibus, cymosis, pedunculatis, circiter 7 cm longis; fructibus globosis, circiter 2 cm diametro, fuscis, obscure striatis, pedicellis 2 ad 4 mm longis.

A glabrous shrub, 1 to 2 m high, the branchlets and branches terete, gray, smooth. Leaves opposite, coriaceous, elliptic to broadly oblong-elliptic, 22 to 33 cm long, 7.5 to 12 cm wide, apex caudate to slenderly acuminate, the base broadly acute, the upper surface brown, the lower paler when dry, shining on both surfaces; primary lateral nerves 16 to 18 on each side of the midrib, distinct, spreading, slightly curved, anastomosing with the equally distinct marginal nerves about 2 to 4 mm from the edge of the lamina, the additional outermost marginal nerves obscure or obsolete, the secondary nerves likewise distinct, the reticulations rather lax, obscure to obsolete; petioles 6 to 13 mm long. Infructescences terminal, cymose, peduncled, about 7 cm in length including the peduncles. Fruits globose, about 2 cm in diameter, dark brown, obscurely striated, the pedicels 2 to 4 mm in length.

LUZON, Isabela Province, San Mariano, *Bur. Sci. 47218* (type), *46973 Ramos and Edaño,* March 26, 1926, along forest streams, at low altitudes, ascending to 700 meters.

In leaf-form and texture, but not in color, apex, base, and reticulations, this species somewhat resembles *Eugenia ellip-*

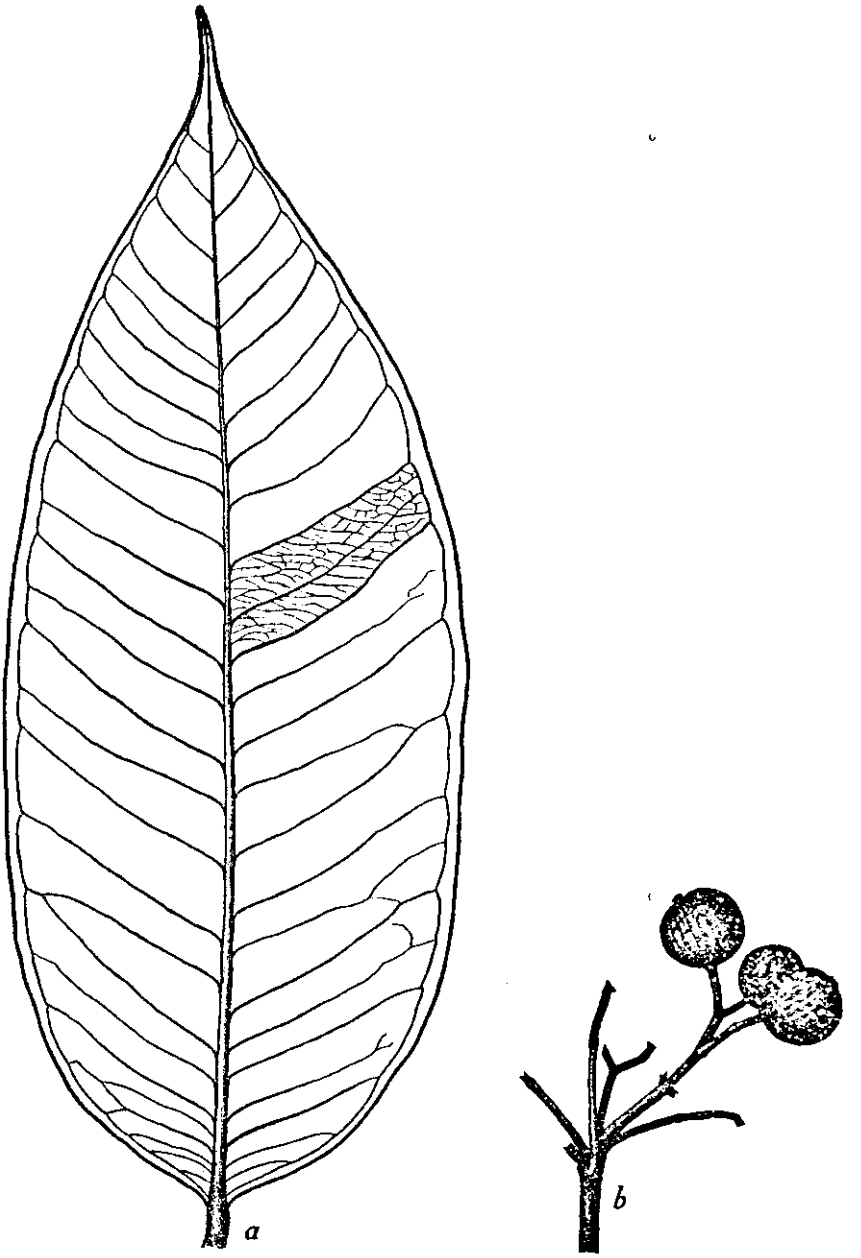


FIG. 13. *Eugenia isabelensis* sp. nov.; *a*, leaf, × 0.5; *b*, infructescence, × 0.5.

tilimba Merr., but differs in its habit, infructescences, and striated fruits.

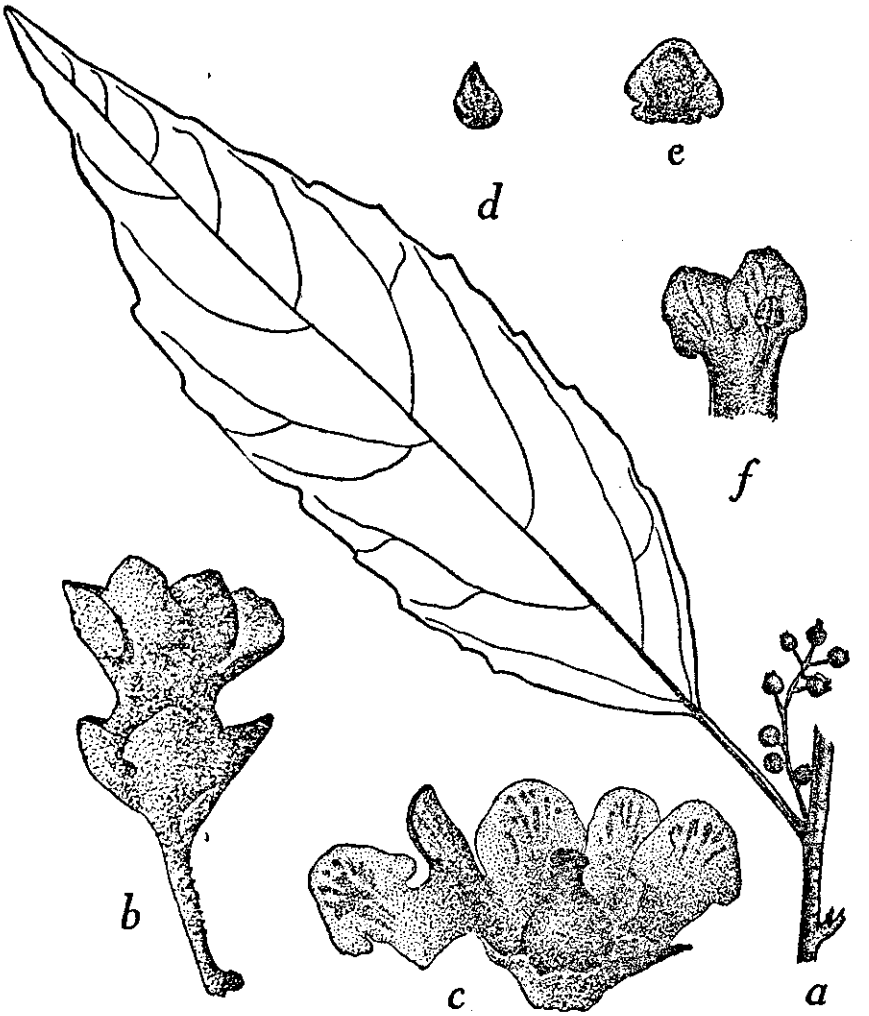


FIG. 14. *Maesa davaensis* sp. nov.: *a*, portion of branch showing leaf and young fruits, × 1; *b*, flower, × 13; *c*, ovary and corolla with stamens not shown, × 13; *d*, bracteole, × 13; *e*, sepal, × 13; *f*, portion of corolla, × 13.

MYRSINACEÆ

Genus MAESA Forskål

MAESA DAVAENSIS sp. nov. § Eumaesa. Text fig. 14.

Frutex circiter 2 m altus, inflorescentiis parce pubescentibus exceptis glaber; ramulis teretibus, lenticellatis; foliis membranaceis, oblongis ad oblongo-lanceolatis, 8.5 ad 13.5 cm longis,

2.5 ad 4 cm latis, acute acuminatis, basi acutis, margine irregulaliter distincte subrepando-dentatis, nervis utrinque 6 vel 7, perspicuis; inflorescentiis axillaribus, 2 ad 2.5 cm longis, laxiuscule racemosis, rariter depauperato-paniculatis; floribus paucis, longe pedicellatis; sepalis orbiculari-ovatis, obtusis ad rotundatis, haud lineatis, margine glabro; corolla 1.75 ad 2 mm longa, lobis usque ad medio connatis, orbiculari-ovatis, rotundatis, haud lineatis, glabris, integris; fructibus ovoideis, circiter 5 mm diametro, pedicellis tenuibus, 3 ad 4 mm longis.

A shrub about 2 m high, glabrous throughout except the slightly puberulent inflorescence; the branches terete, dark brown, prominently lenticellate, 2.5 to 3 mm in diameter. Leaves membranaceous, oblong to oblong-lanceolate, 8.5 to 13.3 cm long, 2.5 to 4 cm wide, the upper surface olivaceous-green, the lower surface brownish olivaceous, apex acutely acuminate, base acute, margins distinctly and irregularly subrepand-dentate; lateral nerves 6 or 7 on each side of the midrib, curved, ascending, anastomosing, prominent, the uppermost ones obscure; petioles slender, 1.3 to 2.8 cm long. Inflorescences axillary, slightly puberulent, laxly racemose or very rarely subpaniculate, with a single branch near the base, 2 to 2.5 cm long. Flowers 5-merous, pale pink, few, their pedicels very slender, slightly puberulent, 2 to 2.5 mm long; bracts lanceolate, acute, about 1 mm long; bracteoles ovate, acute, about 0.75 mm long; sepals orbicular-ovate, obtuse to rounded, not lineate, the margins glabrous, about 1 mm long; corolla 5-lobed, 1.75 to 2 mm long, the lobes united to the middle, orbicular-ovate, rounded, glabrous, not lineate, entire; stamens inserted about the middle of the tube, the filaments about twice as long as the anthers; stigma capitate. Fruits ovoid, about 5 mm in diameter, the pedicels very slender, 3 to 4 mm long.

MINDANAO, Davao Province, Mati, *Bur. Sci. 49123 Ramos and Edaño*, April 9, 1927, on forested slopes at low altitudes.

This species is probably most closely allied to *Maesa chisia* Don, differing in its very much shorter inflorescences, smaller flowers, orbicular-ovate, rounded sepals and petals, and its capitate stigmas.

ASCLEPIADACEÆ

Genus SCHLECHTERIANTHUS nom. nov.

Petalonema SCHLECHTER, Fedde Repert. 13 (1915) 544, non Gilg, 1897.

Schlechter in proposing the generic name *Petalonema* overlooked the fact that Gilg had already used the same name for

a genus of melastomataceous plants in 1897, hence the necessity of establishing a new name for the Philippine asclepiadaceous genus. Dr. L. M. Guerrero called my attention to this oversight.

SCHLECHTERIANTHUS MERRILLII (Schltr.) comb. nov.

Petalonema merrillii SCHLTR. in Fedde Repert. 13 (1915) 544; MERR., Enum. Philip. Fl. Pl. 3 (1923) 356.

A monotypic endemic genus represented by several collections from Bontoc and Benguet Subprovinces, Luzon.

VERBENACEÆ

Genus CLERODENDRON Linnæus

CLERODENDRON APAYAOENSE sp. nov. Eucclerodendron, § Paniculata. Text fig. 15.

Frutex circiter 1 m altus, pubescente; foliis ovatis, chartaceis, circiter 37 cm longis, 18.5 cm latis, breviter acute acuminatis, basi rotundatis vel subtruncatis, utrinque pubescentibus, subtus eglandulosis, margine late dentatis; inflorescentiis terminalibus, paniculatis, pedunculatis, circiter 11 cm longis; bracteis paucis; calycibus indifundibuliformibus, circiter 1 cm longis, pubescentibus, lobis lanceolatis, acuminatis, 1 ad 1.3 cm longis, extus pubescentibus et glandululis, paucis instructis, intus glabris; corollae tubo cylindrico, parce pubescente, 18 ad 20 mm longo, 1.5 mm diametro, lobis anguste oblongis, obtusis, 6 ad 7 mm longis, 3 ad 4 mm latis; filamentis 1.2 ad 1.3 cm longis.

An erect shrub about 1 m high, all parts more or less pubescent with rather short, soft, spreading pale-brownish hairs. Younger stems somewhat 4-angled, densely pubescent. Leaves ovate, chartaceous, about 37 cm long, 18.5 cm wide, the margins broadly toothed, the base broad, rounded or subtruncate, the apex shortly and acutely acuminate, the upper surface pubescent with scattered hairs, the lower surface more densely pubescent and eglandular; lateral nerves about 11 on each side of the midrib, prominent, ascending; the petioles densely pubescent, 12.5 to 13 cm long. Inflorescences terminal, paniculate, about 11 cm long and nearly as wide, the primary branches spreading, the lower ones 7 to 9 cm long, subtended by reduced leaves, all parts pubescent. Bracts foliaceous, scattered, ovate-lanceolate, 1 to 1.5 cm long, pubescent, the bracteoles similar but smaller. Flowers pinkish white. Calyx funnel-shaped, pubescent outside, glabrous inside, about 1 cm long, 1 cm in diameter, the lobes lanceolate, acuminate, and with few glands outside, 10 to 13 mm long, about 4 mm wide. Corolla tube straight, cylindric, 18 to 20 mm long, about 1.5 mm in diameter, somewhat

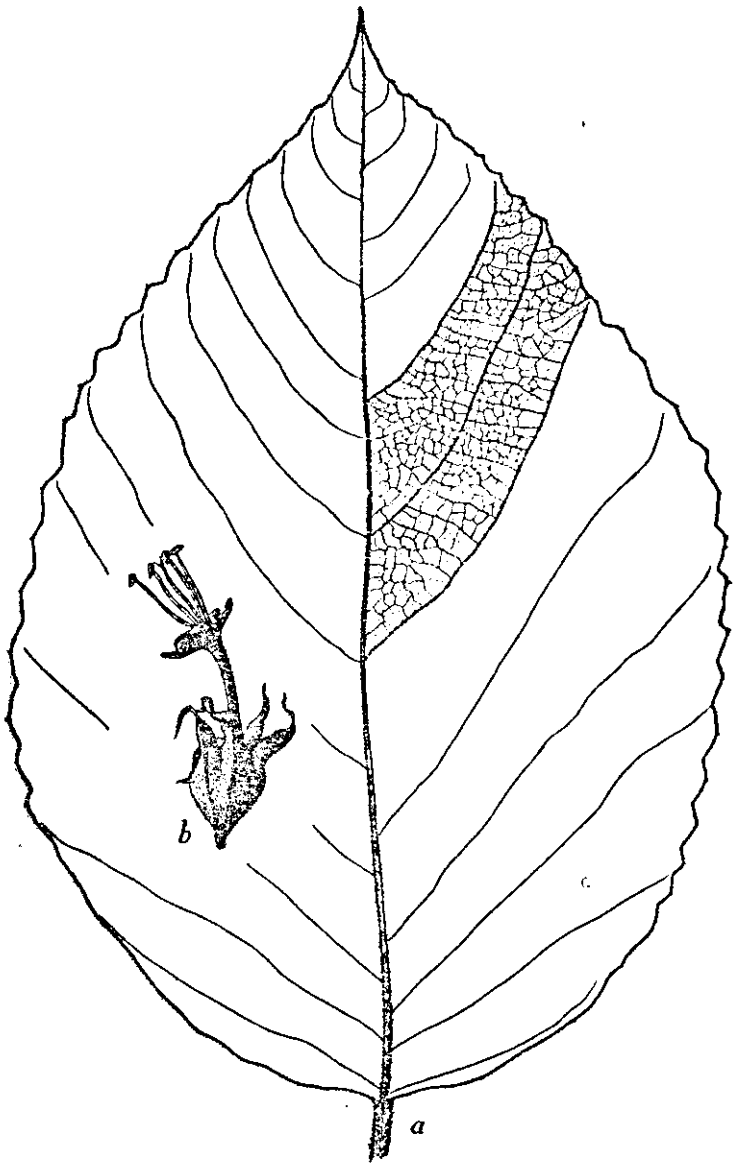


FIG. 15. *Clerodendron apayaoense* sp. nov.; *a*, leaf, × 0.5; *b*, flower, × 1.

pubescent, the lobes narrowly oblong, obtuse, 6 to 7 mm long, 3 to 4 mm wide, spreading and recurved. Filaments exserted, filiform, slightly curved, 1.2 to 1.3 cm long.

LUZON, Apayao Subprovince, Allokapan, *Vanoverbergh 17592*, August 4, 1927, in forests, altitude about 50 meters.

A species allied to *Clerodendron infortunatum* Linn., differing from it in its calyx and corolla.

SCROPHULARIACEÆ

Genus VERONICA Linnæus

VERONICA JAVANICA Blume.

Veronica javanica BLUME, Bijdr. (1826) 742; BENTH. in DC. Prodr. 10 (1846) 489; HOOK. f., Fl. Brit. Ind. 4 (1884) 296.

LUZON, Lepanto Subprovince, Mount Data and vicinity and Pauai, *Mrs. Clemens 7314, 17833, 18798, s. n.* near trails, altitude above 2,000 meters. India to Java, southeastern China, Formosa, and the Riu Kiu Islands; introduced in Brazil. The determination of *17833* is by Dr. Francis Pennell, of the Philadelphia Academy of Natural Sciences. The second species of the genus to be found in the Philippines.

GESNERIACEÆ

Genus CYRTANDRA Forster

CYRTANDRA AERUGINOSA sp. nov. § Dissimiles. Text fig. 16.

Frutex erectus, circiter 50 cm altus, perspicue dense aeruginoso- vel castaneo-villosus; foliis oppositis, lanceolatis ad oblanceolatis 6 ad 17 cm longis, 1.7 ad 4 cm latis, chartaceis, in paribus inaequalibus, apice tenuiter acuminatis, basi cuneatis, margine distanter dentato, nervis primariis utrinque 8 ad 11, perspicuis; inflorescentiis axillaribus, usque ad 3.5 cm longis, umbellatis, pedunculatis, bracteis, lanceolatis; calycibus persistentibus, tubulosus, tubo cylindrico, 4.5 ad 5 mm longo, lobis lanceolatis, tenuiter acuminatis, 1 ad 1.5 mm longis; corolla alba, plus minusve ciliata, circiter 1.8 cm longa; ovario anguste oblongo, glabro; stylis quam ovario paullo longioribus, ciliatis.

An erect shrub, about 50 cm high, all parts more or less densely covered with æruginous or castaneous, subappressed, villous hairs, the younger parts very densely pubescent. Branches terete, the younger parts obscurely and minutely ridged. Leaves opposite, in unequal pairs, chartaceous, lanceolate to oblanceolate, 6 to 17 cm long, 1.7 to 4 cm wide, apex slenderly acuminate, narrowed to the cuneate base, margins distantly dentate; lateral nerves 8 to 11 on each side of the midrib, very prominent, the midrib, lateral nerves and reticulations dark brown, contrasting with the paler parenchyma; petioles 4 to 13 mm long, those of the smaller leaves of each pair shorter than those of the larger ones. Inflorescences axillary, few-flowered, umbellate, up to 3.5

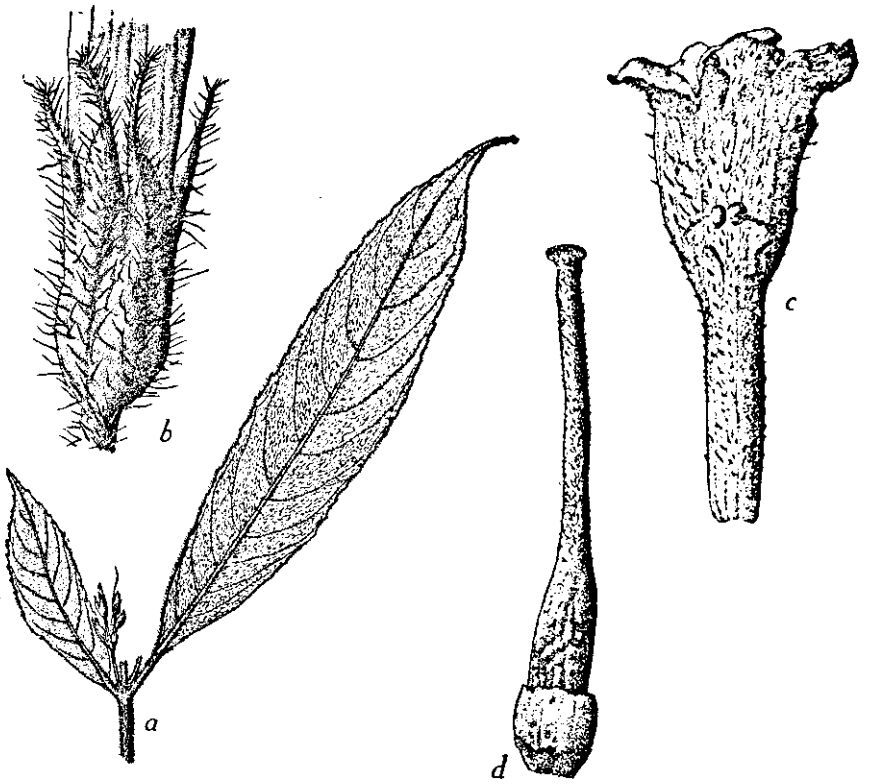


FIG. 16. *Cyrtandra aeruginosa* sp. nov.; *a*, habit, × 0.5; *b*, calyx and portion of corolla, × 6.5; *c*, corolla, × 3.25; *d*, pistil, × 6.5.

cm long, the peduncles 10 to 12 mm long; bracts lanceolate, acuminate, 8 to 13 mm long, free, the bracteoles similar but smaller. Flowers white, pedicellate, the pedicels slender, 6 to 7 mm long. Calyx persistent, the tube cylindric, 4.5 to 5 mm long, lobes lanceolate, slenderly acuminate, 1 to 1.5 mm long; corolla white, more or less ciliate, about 1.8 cm long. Ovary narrowly oblong, glabrous; the style much longer than the ovary, ciliate. Fruits very young, glabrous.

LUZON, Isabela Province, Mount Moises, *Bur. Sci. 47320 Ramos and Edaño*, March 1, 1926, on forested slopes, altitude about 1,200 meters.

A species allied to *Cyrtandra castanea* Merr., but distinguished by its smaller umbellate flowers, smaller tubular calyx, densely pubescent, chartaceous, dentate, lanceolate to oblanceolate leaves, and glabrous ovaries.

FIG. 17. *Cyrtandra disparifolia* sp. nov.; *a*, habit, × 0.5; *b*, calyx and portion of corolla, × 6.5; *c*, corolla, × 6.5; *d*, pistil, × 6.5.

CYRTANDRA DISPARIFOLIA sp. nov. § Stellatæ. Text fig. 17.

Frutex erectus, circiter 1 m altus, ramulis et petiolis et inflorescentiis disperse adpresse castaneo-ciliatis; foliis oppositis, paribus valde inaequalibus, chartaceis, ellipticis, majoribus 13

ad 16.5 cm longis, 4.5 ad 6 cm latis, in minoribus 5 ad 7 cm longis, 1.5 ad 3 cm latis, acuminatis, basi acutis, margine distanter dentatis, supra glabris et olivaceo-viridibus, subtus castaneo-ciliato-setosis, brunneis, nervis primariis utrinque 7 ad 9, subtus valde perspicuis; inflorescentiis axillaribus, umbellatis vel depauperato-paniculatis, pedunculatis; calycibus ciliatis, tubo 2 ad 3 mm longo, lobis lineari-lanceolatis, 4 ad 5 mm longis; corolla alba, ciliata, 10 ad 11 mm longa; ovario oblongo, cylindrico, circiter 4 mm longo, glabro; stylis 4 ad 5 mm longis, ciliatis.

An erect shrub, about 1 m high, the branchlets, petioles, and inflorescences with numerous appressed, castaneous ciliate hairs. Branches terete, brown, branchlets slender, 2 to 3 mm in diameter. Leaves opposite, in very unequal pairs, chartaceous, elliptic, the larger ones of each pair 13 to 16.5 cm long, 4.5 to 6 cm wide, the smaller ones 5 to 7 cm long, 1.5 to 3 cm wide, acuminate, the base acute, margins distantly toothed, the upper surface glabrous, dark olivaceous-green when dry, the lower surface conspicuously castaneous-ciliate-setose, particularly on the nerves, brown; lateral nerves 7 to 9 on each side of the midrib, very prominent beneath, dark brown in contrast with the paler parenchyma, curved, ascending, the reticulations lax, distinct; petioles 9 to 17 mm long in the larger leaves, 5 to 7 mm long in the smaller ones. Inflorescences axillary, slender, in simple or depauperately compound umbels, the primary peduncles 5 to 11 mm long, the secondary ones more slender and about the same length; bracts linear-lanceolate, 6 to 11 mm long, the bracteoles similar but smaller. Calyx ciliate, the tube funnel-shaped, 2 to 3 mm long, the lobes 5, linear-lanceolate, 4 to 5 mm long. Corolla white, somewhat ciliate outside, 10 to 11 mm long. Ovary oblong, cylindric, about 4 mm long, glabrous; the style 4 to 5 mm long, ciliate; stigma subcapitate.

LUZON, Isabela Province, San Mariano, *Bur. Sci. 46751 Ramos and Edaño,* March 15, 1926, along forested streams, altitude about 500 meters. The collectors report that the lower surface of the leaves is red when fresh.

It is difficult to determine the exact affinity of this species, although I am certain that it belongs in the section Stellatæ. It is probably allied to *Cyrtandra reticosa* C. B. Clarke and is well characterized by its slender, simple or depauperately compound umbellate inflorescences. It differs from *C. reticosa* C. B. Clarke in its indumentum, smaller leaves and flowers, and glabrous ovaries.

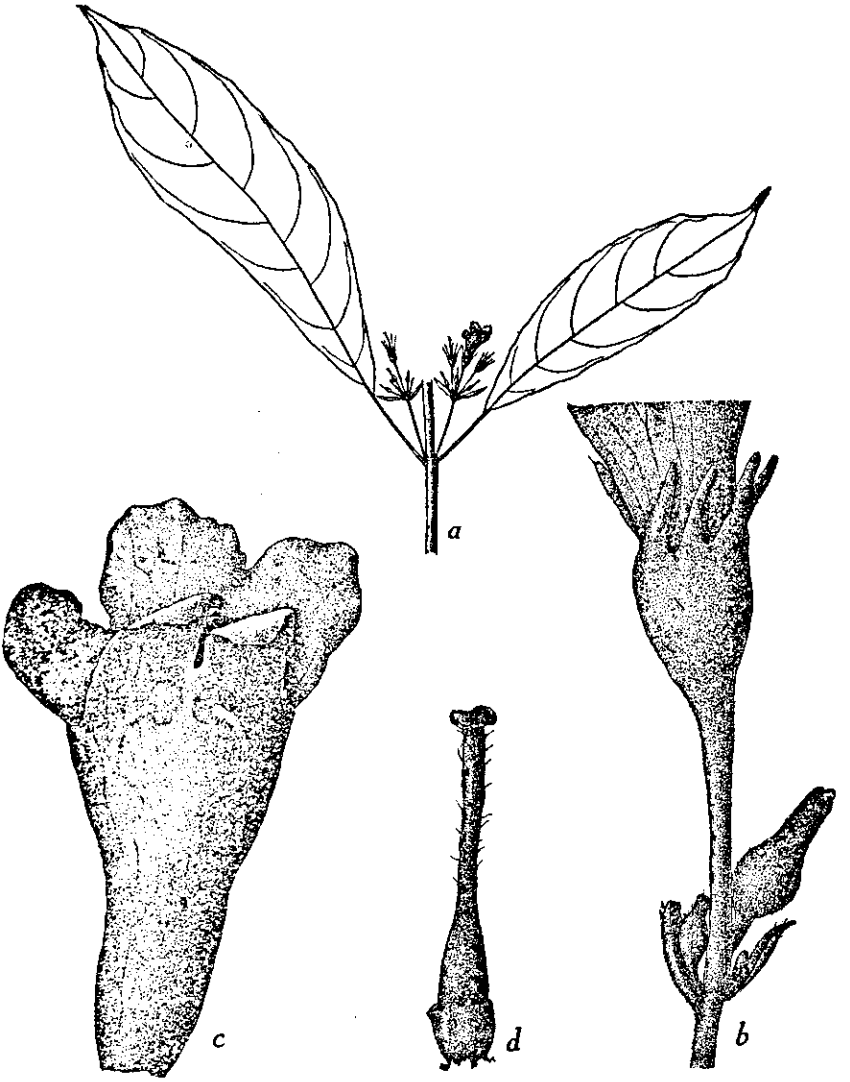


FIG. 18. *Cyrtandra glabrilimba* sp. nov.; *a*, habit, × 0.5; *b*, calyx, flower buds and bracts, × 6.5; *c*, corolla, × 6.5; *d*, pistil, × 6.5.

CYRTANDRA GLABRILIMBA sp. nov. § Polynesiae? Text fig. 18.

Frutex subglaber, inflorescentiis parce pubescentibus; foliis oppositis, oblanceolatis ad oblongo-oblanceolatis, chartaceis, in paribus distincte inaequalibus, 6.5 ad 18 cm longis, 1.5 ad 3.8 cm latis, utrinque glabris, attenuatis, acute acuminatis, basi acutis, margine distanter et obscure undulato-denticulato, vix integro, nervis primariis utrinque 6 ad 8, subobscuris; inflorescentiis

axillaribus, umbellatis vel depauperato-paniculatis, paucifloris, laxis, quam folia brevioribus, graciliter pedunculatis; floribus circiter 10 mm longis; calycis tubo 2 ad 3 mm longo, lobis e basi lanceolatis linearis, 2 ad 2.5 mm longis; ovario anguste oblongo-lanceolato.

An erect shrub, about 1 m high, glabrous throughout except the inflorescences. Branches and branchlets slender, brown to dark brown, terete, when dry more or less ridged. Leaves opposite, in distinctly unequal pairs, chartaceous, oblanceolate to oblong-oblanceolate, 6.5 to 18 cm long, 1.5 to 3.8 cm wide, narrowed above to the rather long and acutely acuminate apex, and below to the acute base, the margins distantly and obscurely repand-denticulate, repand, or nearly entire, the upper surface olivaceous-brown, the lower surface paler, both surfaces smooth, shining and glabrous; lateral nerves 6 to 8 on each side of the midrib, somewhat obscure, ascending, the reticulations very lax, obscure to obsolete; petioles of the larger leaves 1.5 to 2.8 cm long, of the smaller ones somewhat shorter. Inflorescences slender, axillary, solitary in the axils of leaves, few-flowered, shorter than the leaves, the flowers in simple or depauperately compound umbels, the primary peduncles 8 to 19 mm long, very slender in the simple umbellate inflorescences, slender in the compound ones, the secondary peduncles very much shorter, 1 to 4 mm long; the bracts linear-lanceolate, 5 to 9 mm long, ciliate at the apex, otherwise glabrous, the bracteoles similar but smaller. Flowers white, 4 to 6 in each umbel, but one or two opening at the same time in each umbel, the pedicels very slender, slightly ciliate to glabrous, 5 to 9 mm in length. Calyx glabrous or nearly so, the tube funnel- or cup-shaped, 2 to 3 mm long, the lobes linear from a lanceolate base, 2 to 2.5 mm in length. Corolla glabrous, about 10 mm long. Ovary narrowly oblong-lanceolate, glabrous, the style longer than the ovary, ciliate.

LUZON, Isabela Province, Mount Moises, *Bur. Sci. 47263 Ramos and Edaño* (type), March 2, 1926, on forested slopes, altitude about 1,250 meters, *Clemens 16989*, April 16–23, 1926, an undershrub in the forests along the trail below the summit, rather frequent.

This species presents most of the characters of the section Polynesiæ except that the calyx tube is not cylindric but short and cup- or funnel-shaped. It closely resembles and is probably allied to *Cyrtandra tenuipes* Merr., differing in its smaller flowers, simple or depauperately compound umbels, shorter and stouter peduncles, and narrowly oblong-lanceolate ovaries.

CYRTANDRA LOHERI sp. nov. § Stellatæ. Text fig. 19.

Species *C. tenuisepalae* similis et affinis, differt pedunculis longioribus, calyces lobis minoribus, tubo longioribus, indumento villoso.

An erect shrub, the branchlets, petioles, and inflorescences densely pubescent with ferruginous-villous hairs. Branches more or less pubescent, terete, gray, the branchlets 1.5 to 2.5 mm

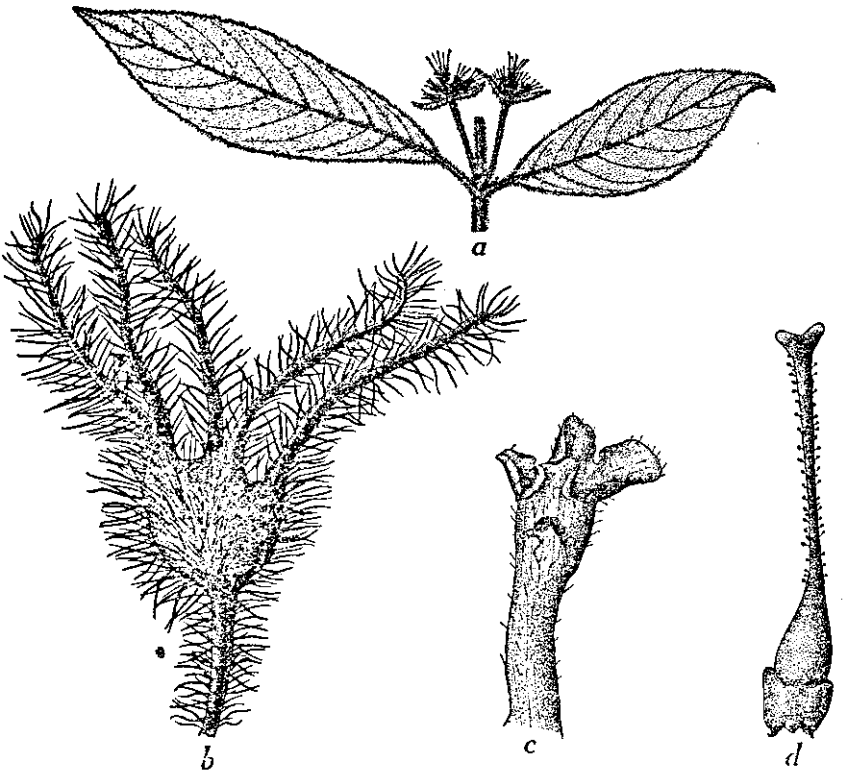


FIG. 19. *Cyrtandra loheri* sp. nov.; *a*, habit, × 0.5; *b*, calyx, × 6.5; *c*, corolla, × 3.25; *d*, pistil, × 6.5.

in diameter, slightly sulcate. Leaves opposite, in subequal pairs, membranaceous, oblanceolate, 4.5 to 10.3 cm long, 1.5 to 3 cm wide, gradually narrowed at both ends, the apex obscurely acuminate, the base acute, the margins serrulate, the upper surface olivaceous-brown, the lower surface paler or ferruginous, the hairs on both surfaces dense, shining, somewhat appressed; lateral nerves 7 to 9 on each side of the midrib, ascending; somewhat distinct on the lower surface, obsolete on the upper surface, the reticulations obsolete; petioles 6 to 16 mm long.

Inflorescences axillary, umbellate, 3 to 4 cm long, 3- to 5-flowered, the peduncles slender, villous, 1.5 to 2.5 cm long; bracts linear-lanceolate, slenderly acuminate, 8 to 11 mm long. Calyx densely villous, the tube cup-shaped, about 2 mm long, the lobes much longer than the tube, very slender, linear, 5 to 6 mm long. Corolla white, ciliate outside, tubular, 10 to 13 mm long. Ovary lanceolate, glabrous, about 2 mm long, 1 mm in diameter, the style about 6 mm long, glandular-ciliate.

LUZON, Rizal Province, Mount Pamingtiñgan, *Loher 12939* (type), March 1912; without definite locality, *Loher 14316*, March 1913.

A species somewhat resembling and allied to *Cyrtandra tenuisepala*, differing in its longer peduncles, smaller flowers, and much shorter calyx lobes, as well as in the villous indumentum on its branchlets, petioles, and peduncles.

CYRTANDRA MUCRONATISEPALA sp. nov. § Polynesiæ. Text fig. 20.

Frutex erectus, aeruginoso-vel castaneo-villosus; foliis oppositis, oblongo-obovatis ad oblongo-oblanceolatis, 7.5 ad 19 cm longis, 2.5 ad 6.3 cm latis, chartaceis, in paribus subaequalibus, acute acuminatis, basi attenuatis, acutis, margine distanter serrato, nervis primariis utrinque 5 ad 7, perspicuis; inflorescentiis axillaribus, 2- vel 3-floris, umbellatis, floribus, 2.8 ad 3.2 cm longis; calycibus persistentibus, tubo cylindrico, circiter 1 cm longo, lobis oblongo-ovatis, mucronatis, 5 ad 8 mm longis, deorsum 4 ad 5 mm latis; corolla, circiter 3 cm longa; stylis quam ovario paullo longioribus, minute ciliato-glandulosis; fructibus ellipsoideis, circiter 15 mm longis, 7.5 mm diametro.

An erect shrub, about 1 m high, all parts covered with æruginous or castaneous, subappressed, villous hairs except the upper surface of the leaves and the branches which become glabrous in age, the hairs on the lower surfaces of the leaves scattered, the younger parts and the petioles densely pubescent. Branches and branchlets terete, somewhat angled. Leaves opposite, in subequal pairs, chartaceous, oblong-obovate to oblong-oblanceolate, 7.5 to 19 cm long, 2.5 to 6.3 cm wide, the apex acutely acuminate, the base narrowed, acute, the margins distantly serrate; lateral nerves 5 to 7 on each side of the midrib, prominent, ascending, curved, the reticulations obsolete, the upper surface olivaceous-brown, glabrous, the lower surface paler, the hairs appressed, dense on the costa and nerves, scattered on the parenchyma; petioles 9 to 33 mm long, those of the smaller leaves of each pair shorter than those of the larger ones. Inflorescences axillary, 2- or 3-flowered, lax, umbellate, about

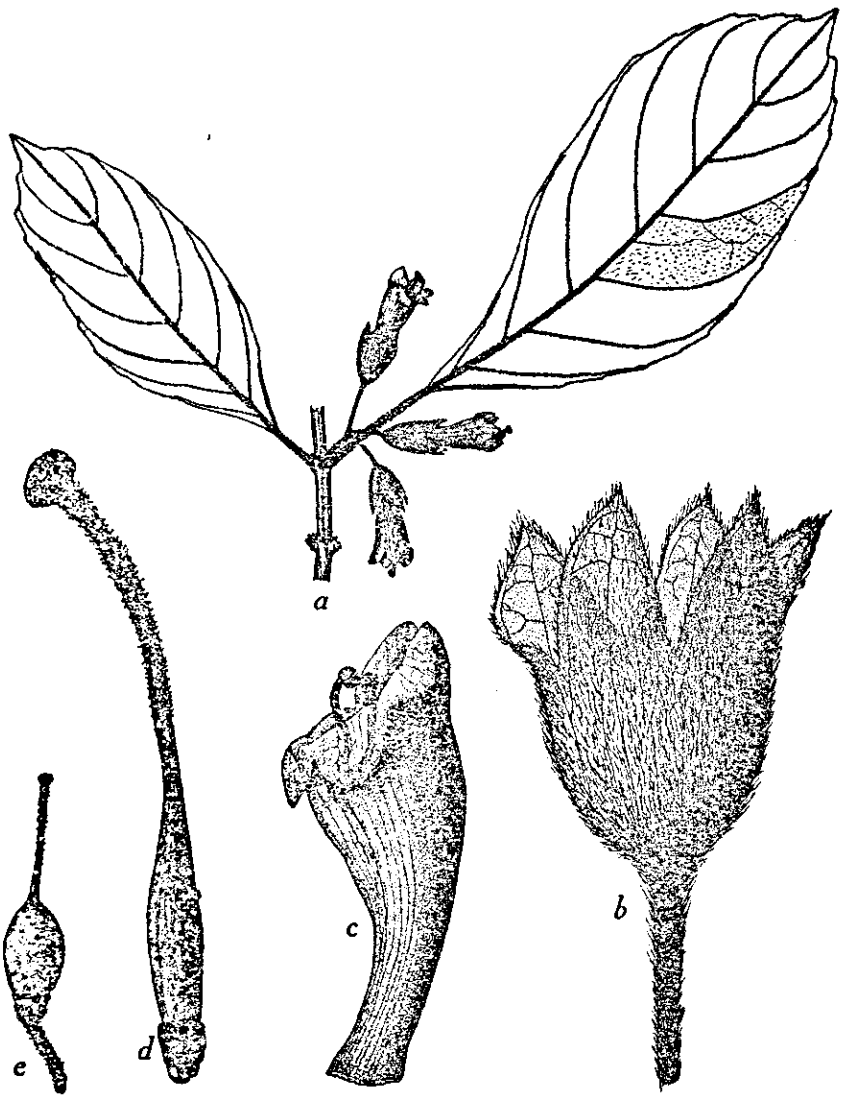


FIG. 29. *Cyrtandra mucronatisepala* sp. nov.; *a*, habit × 0.5; *b*, calyx, × 3.25; *c*, corolla, × 2; *d*, pistil, × 3.25; *e*, fruit, × 1.

4.5 cm long, the peduncles about 8 mm in length; the bracts ovate-lanceolate, about 9 mm long. Flowers white when fresh, 2.8 to 3.2 cm long, the pedicels 9 to 15 mm long. Calyx persistent, densely ferruginous-pubescent, the tube cylindric, about 10 mm long, the lobes oblong-ovate, mucronate, 5 to 8 mm long. Corolla glabrous, about 3 cm long. Ovary lanceolate, glabrous,

the style longer than the ovary, minutely glandular-ciliate. Fruits ellipsoid, about 15 mm long, 7.5 mm in diameter.

MINDANAO, Davao Province, Mount Mayo, *Bur. Sci. 49427 Ramos and Edaño* (type), May 20, 1927, along forested streams, altitude about 1,300 meters; Mount Galintan, *Bur. Sci. 48923 Ramos and Edaño,* on slopes in damp forests, altitude about 1,000 meters.

A species similar to and apparently closely allied to *Cyrtandra lobbi* C. B. Clarke, but with entirely different calyx lobes which are oblong-ovate, mucronate.

CYRTANDRA SIMILIS sp. nov. § Cuneatæ? Text fig. 21.

Frutex erectus, circiter 1 m altus, dense ferrugineo-pubescente; foliis in paribus paullo inaequalibus, membranaceis, oblongo-ellipticis, usque ad 21 cm longis et 7 cm latis, inaequilateralibus, tenuiter acute acuminatis, basi acutis, margine serrato, nervis primariis utrinque 10 vel 11; inflorescentiis axillaribus, 3- vel 4-floris, usque ad 6.5 cm longis, umbellatis, pedunculatis, bracteis bracteolisque lanceolatis, liberis; floribus ciliato-glandulosis, 2.3 ad 2.5 cm longis; calycibus persistentibus, lobis acutis, tenuiter acuminatis, quam tubo paullo brevioribus; corolla flavida, 2.3 ad 2.5 cm longa, plus minusve ciliato-glandulosa; stylis pubescentibus, elongatis; fructibus elliptico-oblongis, circiter 11 mm longis, 4 mm diametro.

An erect shrub, about 1 m high, all parts more or less densely covered with ferruginous, shining hairs; the younger parts very densely pubescent. Branches terete. Leaves opposite, in somewhat unequal pairs, membranaceous, oblong-elliptic, 5.5 to 21 cm long, 2.5 to 7 cm wide, inequilateral, apex slenderly acutely acuminate, the base acute, margins distantly serrate; lateral nerves 10 or 11 on each side of the midrib, prominent; petioles 0.5 to 2.3 cm long, those of the smaller leaves of each pair shorter than those of the larger ones. Inflorescences axillary, 3- of 4-flowered, umbellate, up to 6.5 cm long, the peduncles slender, 1.7 to 3.5 cm long; the bracts lanceolate, acuminate, 8 to 13 mm long, free, the bracteoles similar, but smaller. Flowers yellowish, glandular-ciliate, pedicellate, the pedicels slender, 5 to 6 mm long. Calyx persistent, the tube cup-shaped, about 3 mm long, the lobes acute, slenderly acuminate, shorter than the tube, 1.5 to 2 mm long. Corolla more or less glandular-ciliate outside. Ovary densely glandular-pubescent, the styles longer than the ovary, glandular-pubescent. Fruits elliptic-oblong, about 11 mm long, 4 mm in diameter, densely glandular-pubescent, the persistent styles 6 to 7 mm long.

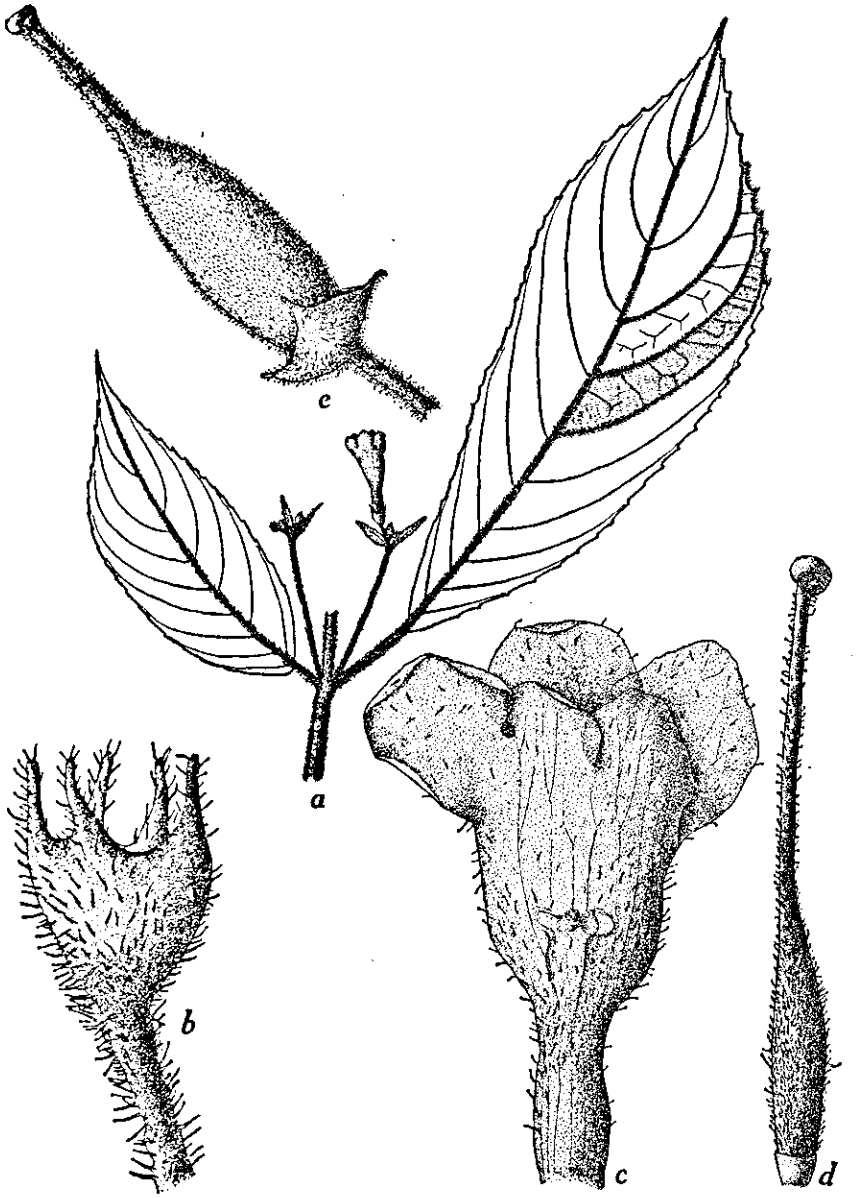


FIG. 21. *Cyrtandra similis* sp. nov.: *a*, habit, × 0.5; *b*, calyx, × 6.5; *c*, corolla, × 3.25; *d*, pistil, × 6.5; *e*, fruit, × 3.25.

LUZON, Nueva Viscaya Province, Mount Alzapan, *Bur. Sci. 45572 Ramos and Edaño*, May 23, 1925, along forested streams at low altitudes.

With the exception of the rather long peduncles this species can safely be placed in the section Cuneatæ. A species apparently allied to *Cyrtandra ferruginea* Merr., but differing in its smaller glandular-ciliate flowers, decidedly smaller cup-shaped calyx, fruits much longer than the calyx, and in its slenderly acutely acuminate leaves.

CYRTANDRA TENUISEPALA sp. nov. § Stellatæ? Text fig. 22.

Frutex ramosus, circiter 1 m altus, ramulis et petiolis et inflorescentiis molliter ferrugineo-pilosis; foliis oppositis, in paribus paullo inaequalibus, membranaceis, anguste elliptico-lanceolatis ad lanceolatis, 3 ad 9.5 cm longis, 0.8 ad 2 cm latis, utrinque attenuatis, apice tenuiter acuminatis, basi acutis, margine distanter serrulatis, utrinque distincte ferrugineo-pilosis, nervis primariis 5 ad 7, obscuris; inflorescentiis axillaribus, umbellatis, 1 ad 1.5 cm diametro, 1-4 floris, breviter pedunculatis, ferrugineo-villosis, pedicellis rigidis; calycibus dense ferrugineo-villosis, indifundibuliformis, tubo 2 ad 3 mm longo, lobis anguste linearis, 10 ad 12 mm longis, densissime ciliatis; corolla alba, tubulosa, 13 ad 15 mm longa; ovario ovoideo, circiter 1.5 mm diametro; stylis circiter 7 mm longis; fructibus dense granulatis, ovoides ad oblongo-ovoideis, 5 ad 7 mm longis, 3.5 ad 5 mm diametro.

An erect shrub, about 1 m high, the branchlets, petioles, and inflorescences rather densely and softly pubescent with ferruginous hairs. Branches glabrous, terete, gray, somewhat angled. Leaves opposite, in somewhat unequal pairs, membranaceous, narrowly elliptic-lanceolate to lanceolate, 3 to 9.5 cm long, 0.8 to 2 cm wide, gradually narrowed at both ends, the apex slenderly acuminate, the base acute, the margins distantly serrulate, the upper surface brown, the lower surface ferruginous, rather prominently ferruginous-pilose on both surfaces; lateral nerves 5 to 7 on each side of the midrib, obscure, ascending, the reticulations obscure to obsolete; petioles 4 to 13 mm long. Inflorescences axillary, umbellate, 1 to 1.5 cm in diameter, 1- to 4-flowered, the peduncles 3 to 6 mm in length; bracts lanceolate, slenderly acuminate, 10 to 15 mm long, 2.5 to 4 mm wide. Calyx densely ciliate, the tube funnel-shaped, 2 to 3 mm long, the lobes very much longer than the tube, very slender, linear, 10 to 12 mm long. Corolla white, ciliate outside, tubular, 13 to 15 mm long. Ovary ovoid, glabrous, about 1.5 mm in diameter, the style about 7 mm in length, ciliate. Fruits densely granular, glabrous, ovoid to oblong-ovoid, 5 to 7 mm long, 3.5 to 5 mm in diameter.

FIG. 22. *Cyrtandra tenuisepala* sp. nov.; *a*, habit, × 0.5; *b*, calyx, × 6.5; *c*, corolla, × 6.5; *d*, pistil, × 6.5; *e*, fruit, × 3.

LUZON, Nueva Vizcaya Province, Mount Alzapan, *Bur. Sci. 45579 Ramos and Edaño,* May 23, 1925, on forested slopes in the mossy forest, altitude about 1,300 meters.

In general appearance this species resembles *Cyrtandra parviflora* C. B. Clarke, but it is distinguished by its calyx and the color of its indumentum. The very short calyx tube and the very slender linear lobes are characteristic.

ACANTHACEÆ

Genus STAUROGYNE Wallich

STAUROGYNE BALABACENSIS sp. nov. Text fig. 23.

Herba erecta e basi prostrata plus minusve ramosa, usque ad 40 cm alta, perspicue pubescens; foliis oblongo-ovatis, 5.5 ad 13 cm longis, 2 ad 5.5 cm latis, acutis ad obscure breviter acuminatis, basi cuneatis; inflorescentiis spicatis, terminalibus, densis, usque ad 4.5 cm longis, pubescentibus, bracteis lanceolatis ad lineari-lanceolatis, tenuiter acuminatis, 13 ad 15 mm longis; floribus confertis, brevissime pedicellatis; sepalis subaequalibus, linearis, longe et tenuitissime acuminatis, 7 ad 13 mm longis, 0.5 ad 1 mm latis, dense ciliato-pubescentibus; corolla circiter 14 mm longa; capsula oblonga, obtusa, 6 ad 7 mm longa.

An erect somewhat branched herb, 15 to 40 cm high, from a prostrate base, the stems flattened when dry, pubescent throughout except the upper surface of the leaves and the corollas. Leaves oblong-ovate, membranaceous, 5.5 to 13 cm long, 2 to 5.5 cm wide, apex acute to obscurely and shortly acuminate, base cuneate, entire or very obscurely undulate-crenate; petioles 10 to 30 mm long. Spikes terminal, solitary, densely flowered, ovoid to oblong, 3 to 4.5 cm long, densely ciliate-pubescent; bracts lanceolate to linear-lanceolate, slenderly acuminate, 13 to 15 mm long, 1.5 to 2 mm wide. Flowers crowded, very shortly pedicellate. Sepals green, subequal, linear, long and slenderly acuminate, 7 to 13 mm long, 0.5 to 1 mm wide, one smaller than the rest. Corolla about 14 mm long, pale violet, the lobes orbicular, rounded. Stamens unequal, included, the filaments hirsute, the anthers when spread about 1.5 mm wide. Ovary glabrous, oblong, about 1.5 mm long, the style about 3 mm long. Capsule oblong, obtuse, cylindric or slightly compressed, sessile, 6 to 7 mm long, about 2 mm in diameter, the base subhastate. Seeds numerous.

BALABAC, Katakupan, *Bur. Sci. 49718 Ramos and Edaño,* November 25, 1927, along streams in damp forests, at low altitudes.

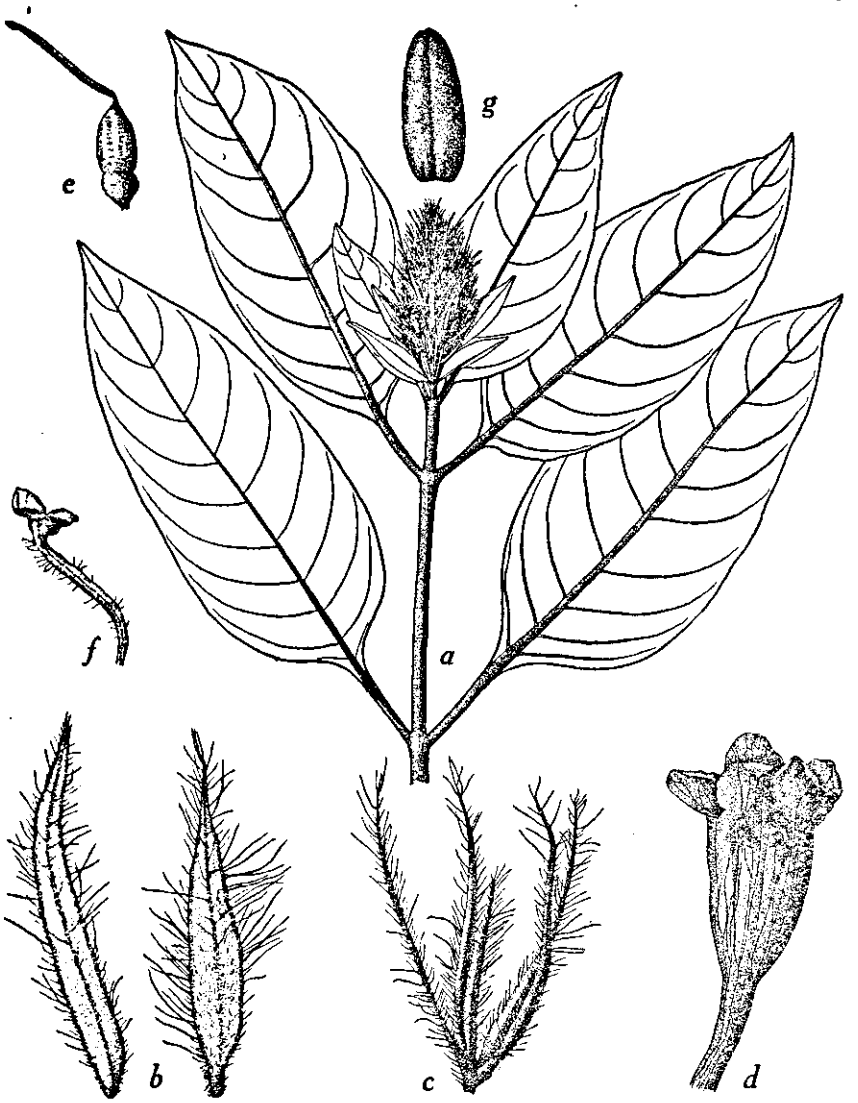


FIG. 23. *Staurogyne balabacensis* sp. nov.; *a*, habit, × 0.5; *b*, bracts, × 3.25; *c*, calyx, × 3.25; *d*, corolla, × 3.25; *e*, pistil, × 6.5; *f*, stamen, × 6.5; *g*, capsule, x 3.25.

A species apparently related to *Staurogyne setigera* (Nees) O. Ktz., differing in its larger spikes, flowers, and leaves.

Genus HEMIGRAPHIS Nees

HEMIGRAPHIS CARDIOPHYLLA sp. nov. Text fig. 24.

Herba tenuis, prostrata, ramosa, pubescens; foliis late cordatis 8 ad 21 mm longis, 9 ad 16 mm latis, obscure crenatis, obtusis

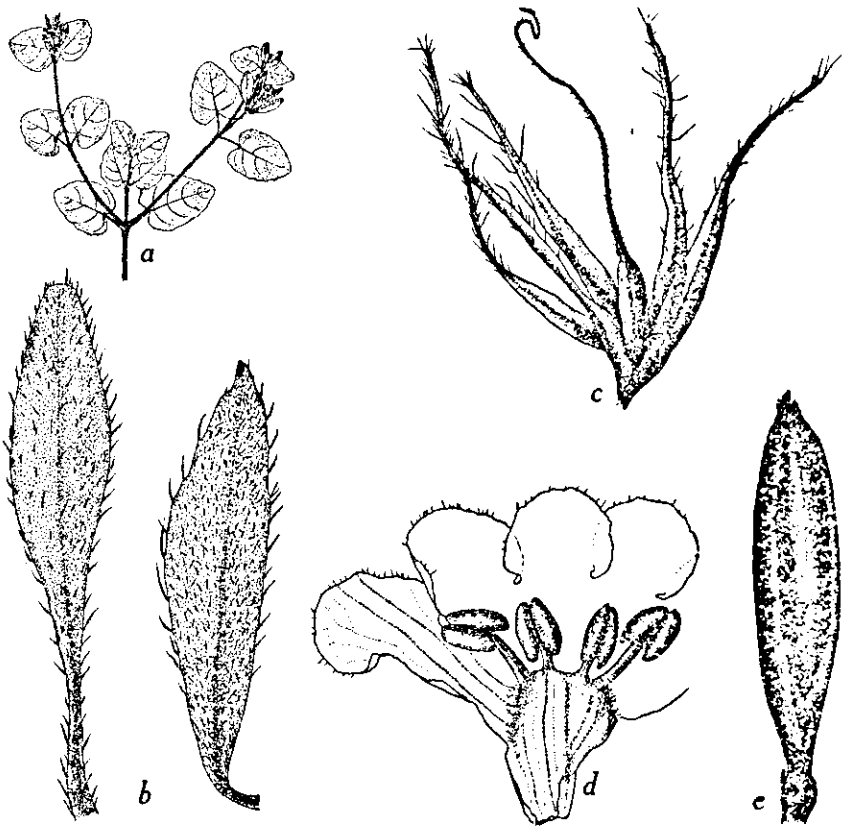


FIG. 24. *Hemigraphis cardiophylla* sp. nov.; *a*, habit, × 0.5; *b*, bracts, × 6.5; *c*, calyx and pistil, × 6.5; *d*, portion of corolla of unopened flower showing stamens, × 6.5; *e*, capsule, × 6.5.

ad rotundatis, basi late cordatis; inflorescentiis terminalibus, subcapitalis, pedunculatis; floribus albis, ebracteolatis; calycis segmentis lineari-lanceolatis, 6.5 ad 8 mm longis, usque ad 0.5 mm latis; corolla circiter 12 mm longa; capsulis anguste oblongis, 8 ad 9 mm longis.

A slender, branched herb, the main branches spreading and prostrate, pubescent, none of the branches more than 1 mm in diameter. Leaves broadly heart-shaped, 8 to 21 mm long, 9 to 16 mm wide, obtuse to rounded, the base broadly cordate, obscurely crenate, olivaceous, hispid, and densely covered with irregularly scattered cystoliths on both surfaces; lateral nerves 3 or 4 on each side of the midrib, not prominent. Inflorescences usually terminal, rarely subaxillary, subcapitate, 4-flowered, peduncled, the peduncles slender, 5 to 8 mm long, in fruit up to 18 mm long;

bracts oblong-oblanceolate to spathulate, about 11 mm long, 2 to 3 mm wide, ciliate. Flowers sessile, white, ebracteolate. Calyx segments nearly free, linear-lanceolate, slenderly acuminate, 6.5 to 8 mm long, up to 0.5 mm wide, ciliate. Corolla about 12 mm long, the lower 6 mm of the tube slender, cylindric then broadened; lobes subequal, orbicular-ovate, ciliate outside. Filaments glabrous, anthers about 1.25 mm long. Ovary glabrous, linear-oblong, about 2.5 mm long; style about 6 mm long, bearded. Capsules narrowly oblong, 8 to 9 mm long, about 1.5 mm in diameter. Seeds about 8, oblong-ovate, flattened, about 1.25 mm long.

TAWITAWI, Sulu Archipelago, *Bur. Sci. 44041 Ramos and Edaño,* July 19, 1924, in secondary forests and in open places at low altitudes.

This species belongs in the group with *Hemigraphis fruticulosa* C. B. Clarke and *H. nummularifolia* Merr. and is most closely allied to the former. It is well characterized by its small broadly heart-shaped leaves.

Bur. Sci. 49301 Ramos and Edaño, from Mati, Davao Province, probably represents a form of the same species with more conspicuously crenate leaves.

Genus RUELLIA Plumier

RUELLIA TUBEROSA Linn.

Ruellia tuberosa LINN., Sp. Pl. (1753) 635; MERR. in Journ. Str. Branch Roy. As. Soc. 76 (1917) 116.

LUZON, Manila, *Bur. Sci. 76600 Quisumbing,* August 30, 1928.

Occasional as an escape from gardens in Manila and neighboring towns. A native of tropical America, naturalized in some parts of the Old World tropics.

RUBIACEÆ

Genus HEDYOTIS Linnæus

HEDYOTIS MINDORENSIS sp. nov. § Euhedyotis. Text fig. 25.

Suffrutex erectus vel scandens ?, ramosus, stipulis, bracteolisque exceptis glaber; foliis chartaceis, oblongo-lanceolatis, 5 ad 18 cm longis, 1.5 ad 5 cm latis, tenuiter acuminatis, basi acutis, nervis lateralibus utrinque 4 ad 6, distantibus; stipulis plus minusve hispidis, pectinato-laciniatis, 6 ad 7 mm longis, segmentis 10 vel 11, subulatis, 1 ad 4 mm longis; inflorescentiis axillaribus, subcapitatis, 4 ad 7 mm diametro, subsessilibus ad tenuiter longisque pedunculatis; floribus confertis, sessilibus vel

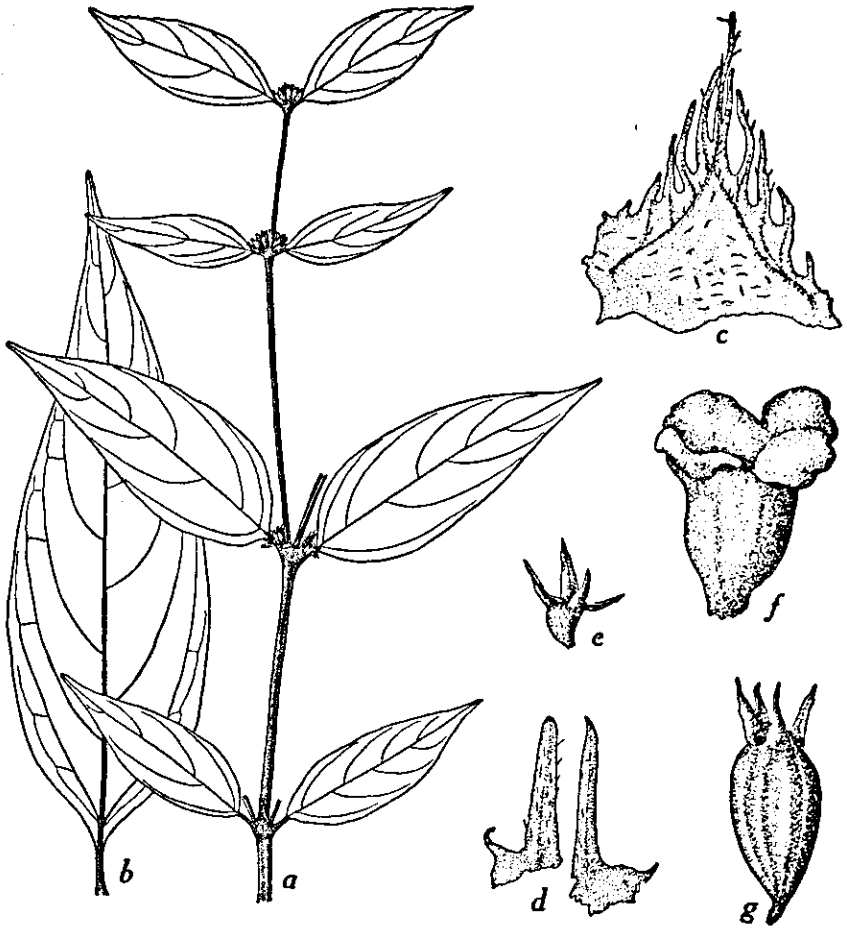


FIG. 25. *Hedyotis mindorensis* sp. nov.; *a*, habit × 0.5; *b*, lower leaf, × 0.5; *c*, stipule, × 6.5; *d*, bracteoles, × 6.5; *e*, calyx, × 6.5; *f*, corolla, × 20; *g*, capsule, × 6.5.

subsessilibus; bracteolis linearis, 2.5 ad 3.5 mm longis, glabris vel ciliato-hirsutis; calycis tubo, circiter 1 mm longo, glabro, lobis 4, lanceolatis, 0.75 ad 1.25 mm longis, glabris; corolla circiter 1.5 mm longa. Capsulis oblongo-obovoideis ad oblongo-oblanceolatis, glabris, longitudinaliter striatis, circiter 3.5 mm longis, 1.5 mm diametro.

An erect or scandent ? branched undershrub, glabrous throughout except the somewhat hispid stipules and ciliate-hirsute bracteoles, the branchlets and branches sulcate and angled when dry. Leaves thinly chartaceous, oblong-lanceolate, 5 to 18 cm long, 1.5 to 5 cm wide, slenderly acuminate, base acute, olivaceous-green when dry; lateral nerves 4 to 6 on each side of the

midrib, distant, ascending, prominent; petioles 5 to 10 mm long; stipules pectinate-laciniate, 6 to 7 mm long, supplied with cystoliths, the laciniæ 10 or 11, subulate, 1 to 4 mm long, the inner ones longer, slightly hispid. Inflorescences axillary, dense, subglobose, 4 to 7 mm in diameter, subsessile to peduncles up to 4 cm long. Flowers numerous, somewhat crowded, sessile or subsessile; bracteoles subtending each flower linear, 2.5 to 3.5 mm long, 0.3 to 0.6 mm wide, glabrous or ciliate-hirsute, and supplied with few cystoliths. Calyx tube funnel-shaped, about 1 mm long, glabrous, the lobes 4, lanceolate, 0.75 to 1.25 mm long, glabrous. Corolla white, about 1.5 mm long, the lobes spreading. Fruits oblong-obovoid to oblong-oblanceolate, glabrous, ridged, about 3.5 mm long, 1.5 mm in diameter.

MINDORO, Puerto Galera, *Bur. Sci. 46363 Ramos,* December 6, 1925, on forested slopes, altitude about 700 meters.

A species characterized by being entirely glabrous except the somewhat pubescent stipules and bracteoles; by its short- and long-peduncled capitate cymes, its oblong-obovoid to oblong-oblanceolate, ridged fruits, its small flowers, with funnel-shaped calyx tubes, and its linear bracteoles.

Genus OPHIORRHIZA Linnæus

OPHIORRHIZA DAVAENSIS sp. nov. Text fig. 26.

Herba tenuis, prostrata vel adsendens, pubescens, pauci ramosa, usque ad 20 cm longa; foliis parvis, subaequalibus, chartaceis, ovatis ad oblongo-ellipticis, 9 ad 26 mm longis, 6 ad 15 mm latis, utrinque acutis ad obtusis vel basi truncatis, supra olivaceo-brunneis, subtus purpurascens, nervis lateralibus utrinque 6 ad 8; cymis tenuiter et brevissime pedunculatis, paucifloris; floribus albis, circiter 5 mm longis, pubescentibus, brevissime pedicellatis, pedicellis circiter 1 mm longis; calycis tubo subgloboso, circiter 1 mm longo, lobis circiter 1 mm longis; corolla cylindrica, tubo circiter 3 mm longo, lobis extus pubescentibus, subaequalibus, 1.25 ad 1.75 mm longis; capsulis compressis, circiter 6 mm latis, 3 mm longis, apice subtruncatis, bilobatis, lobis inaequalibus, anguste rotundatis.

A slender, prostrate or ascending, branched herb, copiously rooting at the lower nodes, up to 20 cm in length, the stem distinctly pubescent. Leaves in subequal pairs, small, thinly chartaceous, ovate to oblong-elliptic, 9 to 26 mm long, 6 to 15 mm wide, subequally narrowed to the acute to obtuse apex and base or the base truncate, the upper surface olivaceous-brown, the lower surface brownish purple, puberulent on both surfaces;

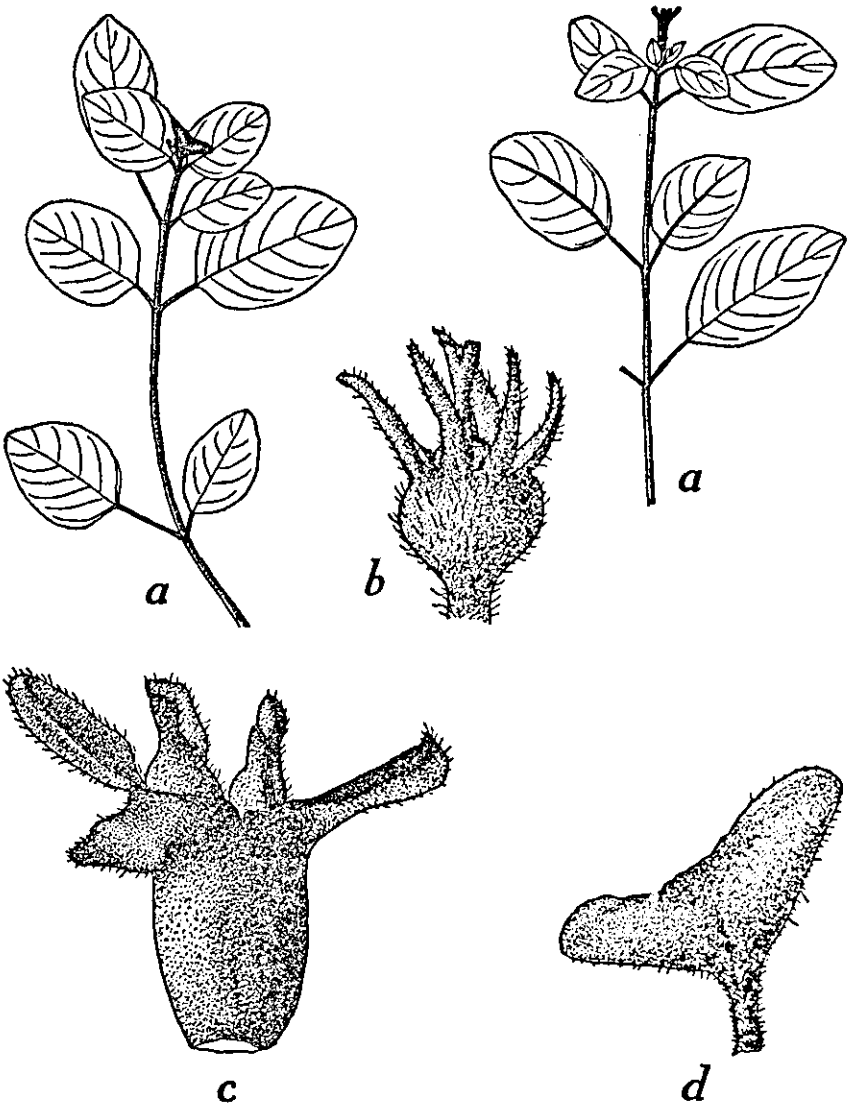


FIG. 26. *Ophiorrhiza davaensis* sp. nov.; *a* habit, × 1; *b*, flower, corolla removed, × 13; *c*, corolla, × 13; *d*, fruit, × 6.5.

lateral nerves 6 to 8 on each side of the midrib, slender, distinct; petioles pubescent, 4 to 10 mm long; stipules linear-lanceolate, about 1.5 mm long. Cymes slenderly and very shortly peduncled, few-flowered, their peduncles densely pubescent, 1 to 2 mm long. Flowers white, about 5 mm long, shortly pedicellate, the pedicels very slender, about 1 mm long. Calyx tube subglobose, about 1 mm long, the lobes lanceolate, about 1 mm long.

Corolla tube cylindric, about 3 mm long, the lobes pubescent outside, subequal, oblong, 1.25 to 1.75 mm long. Capsules slightly pubescent, compressed, about 6 mm wide, 3 mm long, apex subtruncate, crowned with the distinct calyx-teeth, bilobed, the lobes unequal, narrowly rounded at their apices.

MINDANAO, Davao Province, Mati, *Bur. Sci. 49307 Ramos and Edaño*, April 6, 1927, on the banks of streams and in open places at low altitudes.

A species close to *Ophiorrhiza tenuis* Merr., and probably allied to it, differing in its larger, ovate to oblong-elliptic subequal leaves which are brownish purple beneath, and its pubescent larger flowers and capsules.

Genus PSYCHOTRIA Linnæus

PSYCHOTRIA BALABACENSIS Merr. Text fig. 27.

Psychotria balabacensis MERR. in Philip. Journ. Sci. 10 (1915) Bot. 127; Enum. Philip. Fl. Pl. 3 (1923) 553.

Inflorescences lax, few-flowered, 7 to 9.5 cm long, the peduncles slender, 5 to 13 mm long, each bearing 3 umbellately dis-

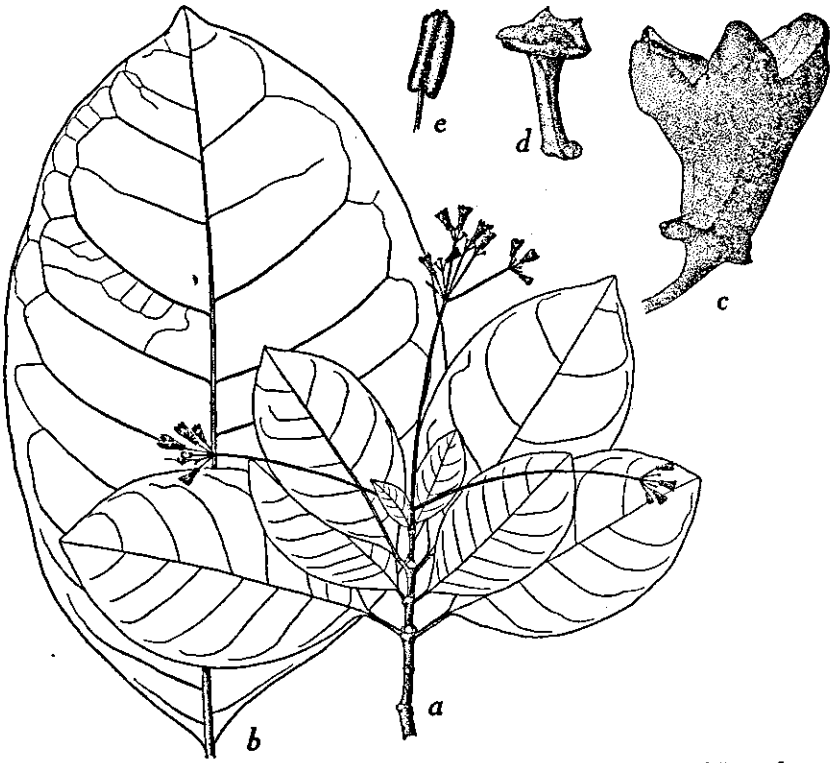


FIG. 27. *Psychotria balabacensis* Merr.: *a*, habit, × 0.5; *b*, lower leaf, × 0.5; *c*, flower, × 6.5; *d*, calyx, × 6.5; *e*, stamen, × 6.5.

posed primary branches, slender, 5 to 9 cm in length, the ultimate branchlets umbellately or cymosely arranged. Flowers yellowish white, 3 to 7 on each ultimate branchlet, glabrous, about 6 mm long, their pedicels 3 to 4 mm long. Calyx about 1 mm long, truncately or irregularly toothed. Corolla tube cylindric, about 5 mm in length, the lobes 4, broadly ovate, obtuse about 1.5 mm long. Anthers about 1.5 mm long.

BALABAC, Mount Caunayan, *Bur. Sci. 49691, 49891 Ramos and Edaño*, November 22, 1927, in forests at low altitudes. Originally described from a fruiting specimen; the above data given to complete the description.

PSYCHOTRIA PUBILIMBA sp. nov. Text fig. 28.

Frutex erectus, 1 ad 2 m altus, partibus junioribus et subtus foliis ad costam nervisque et inflorescentiis minutissime castaneo- vel subrubiginoso-pubescentibus; foliis lanceolatis, subcoriaceis, 10 ad 20 cm longis, 2.5 ad 4.5 cm latis, utrinque angustatis, acuminatis, basi acutis, utrinque nitidis, nervis utrinque 14 ad 18, valde perspicuis, arcuato-anastomosantibus, reticulis delicatis, distinctis; petiolo 10 ad 23 mm longo; paniculis 3 ad 3.5 cm longis sessilibus, e basi ramosis; floribus albis, circiter 7.5 mm longis, brevissime (1 ad 2 mm) pedicellatis; calycibus circiter 3 mm longis; corollae tubo cylindrico, circiter 1.5 mm longo, extus minutissime puberulo, intus dense villoso, lobis lanceolatis, obtusis, circiter 2 mm longis; fructibus breviter pedicellatis, ovoideis, 4 ad 4.5 mm longis, nitidis, haud sulcatis; seminibus plano-convexis, albumine ruminato.

An erect shrub, glabrous except the branchlets, the lower surface of the leaves and inflorescences which are densely and minutely covered with dark brown very short hairs; branches terete, slightly ridged. Leaves somewhat purplish when dry, subcoriaceous, lanceolate, 10.5 to 19.5 cm long, 2.5 to 4.5 cm wide, narrowed at both ends, apex acuminate, base acute, upper surface olivaceous-purple-brown, lower surface somewhat dark brown, smooth and somewhat shining on both surfaces; lateral nerves 14 to 18 on each side of the midrib, very conspicuous, parallel, prominently arched-anastomosing, the reticulations delicate, distinct on the lower surface; petioles 10 to 23 mm long. Panicles sessile, many-flowered, 3 to 3.5 cm long, with one longer central branch and two shorter lateral basal branches. Flowers white, about 7.5 mm long, shortly pedicellate, the pedicels 1 to 2 mm long. Calyx about 3 mm long, minutely puberulent, the teeth minute. Corolla tube cylindric, minutely puberulent with-

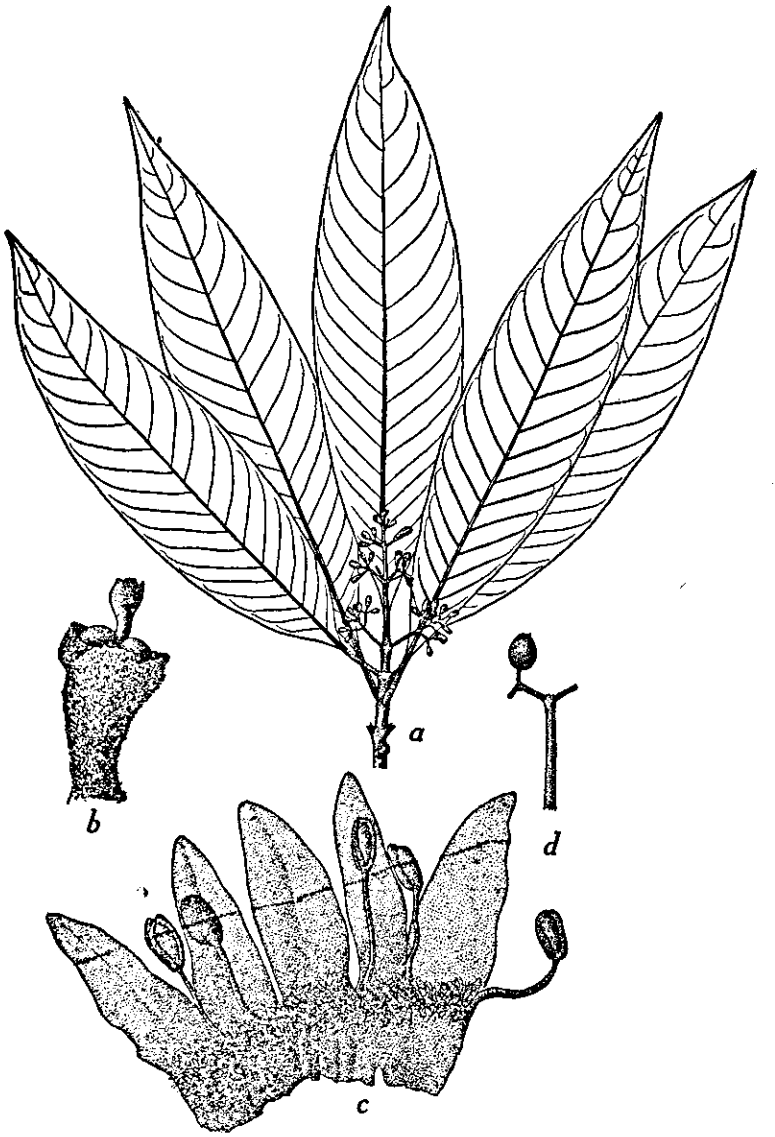


FIG. 28. *Psychotria pubilimba* sp. nov.; *a*, habit, × 0.5; *b*, flower, corolla removed, × 6.5; *c*, corolla, opened, × 6.5; *d*, fruit, × 1.

out, densely villose within, about 1.5 mm long, the lobes lanceolate, obtuse, about 2 mm long. Fruits shortly pedicellate, dark reddish-brown when dry, ovoid, apex subtruncate, 4 to 4.5 mm long, smooth, obscurely ridged. Seeds plano-convex, smooth, not ridged; albumen ruminate.

LUZON, Isabela Province, San Mariano, *Bur. Sci. 47221 Ramos and Edaño* (type), March 26, 1926, along streams in damp forests, altitude about 700 meters; Mount Moises, *Bur. Sci. 47321 Ramos and Edaño,* March 1, 1926, on forested slopes, altitude about 1,000 meters.

A species well characterized by its dark brown characteristic indumentum, lanceolate leaves, and smooth ovoid fruits.

COMPOSITÆ

Genus GALINSOGA Ruiz and Pavon

GALINSOGA PARVIFLORA Cav.

Galinsoga parviflora CAV. in Icon. 3 (1794) 41, *t. 281;* DC., Prodr. 5 (1834) 677; HOOK. f., Fl. Brit. Ind. 3 (1882) 311.

LUZON, Benguet Subprovince, Trinidad Farm School, *Clemens 18499, 18808,* det. Mrs. Clemens, August 5 and December, 1928.

Growing as a weed at the Trinidad Farm School, undoubtedly introduced with vegetable or flower seeds from the United States. Native of tropical America now widely distributed in temperate, subtemperate, and tropical regions of the world.

ILLUSTRATIONS

PLATE 1

Ficus balabacensis sp. nov.; *1*, fruiting branch, × 0.5; *2*, a leaf, × 0.5; *3*, base of a leaf, × 0.5; *4*, stipule, × 0.5; *5*, apex of receptacle, × 0.5; *6*, base of receptacle, × 0.5; *7*, male flower with one stamen and one gall pistil, × 6; *8*, achene, × 5.

PLATE 2

Thottea philippinensis sp. nov.; *1*, a branch, × 0.5; *2*, side view of flower before anthesis, × 0.5; *3*, top view of flower before anthesis, × 0.5; *4*, column bearing upper and lower rows of stamens and stigmas, × 6.5; *5*, two stamens of the upper row, × 6.5; *6*, perianth (p), cut open showing stigmas (st), and upper (s^1) and lower (s^2) rows of stamens, × 1.25.

PLATE 3

Derris ferruginoides sp. nov.

TEXT FIGURES

FIG. 1. *Laportea stenophylla* sp. nov.; *a*, a leaf, × 0.5; *b*, a flower showing perianth, bract, and bracteoles, × 6.5; *c*, stamens and rudimentary ovary, × 6.5.

2. *Elatostema brunonianum* sp. nov.: *a*, fruiting stem, × 0.5; *b*, fused outer bracts, × 6.5; *c*, achene, (a), perianth lobes, one of the inner bracts and bracteoles, × 6.5; *d*, inner bracts, × 6.5; *e*, base of leaf, upper surface, × 3.25.

3. *Elatostema iridense* sp. nov.; *a*, fruiting branch, natural size; *b*, base of leaf, upper surface, × 13; *c*, pair of outer bracts, × 13; *d*, inner bract, × 13; *e*, bracteoles and achenes, × 13; *f*, achene, greatly enlarged.

4. *Papualthia longipes* sp. nov.; *a*, a leaf, × 0.5; *b*, a flower, × 0.5; *c*, detail of a flower with the petals removed showing sepals, region of attachment of the stamens and carpels, × 6.5; *d*, carpel, × 6.5; *e*, stamens, × 6.5.

5. *Derris ferruginoides* sp. nov.: *a*, leaf, × 0.5; *b-c*, leaflets, × 0.5; *d*, flower with petals removed, × 2; *e*, keel, × 2; *f*, wing, × 2; *g*, standard, × 2; *h*, fruit, × 0.5.

6. *Aglaia ramosii* sp nov.; *a*, a flowering branch, showing a leaf, and the whole length of a panicle with the branches removed, × 0.5; *b*, a branch of the panicle, × 0.5; *c*, a flower, × 6.5; *d*, hooded and flat petals, × 6.5; *e*, a flower with the petals removed, showing staminal tube and calyx, × 6.5; *f*, longitudinal section of the staminal tube showing stamens, × 6.5; *g*, ovary, × 6.5.

FIG. 7. *Trigonostemon filiforme* sp. nov.; *a*, a flowering branch, × 0.5; *b*, female flower with the petals removed, showing sepals and pistil, × 6.5; *c*, petals of female flower, × 6.5; *d*, sepal of male flower, × 6.5; *e*, petal of male flower, × 6.5; *f*, stamen, × 6.5.

8. *Trigonostemon stenophyllus* sp. nov.; *a*, a fruiting branchlet, × 0.5; *b*, female flower showing ovary and two sepals, × 6.5; *c*, a sepal, × 6.5; *d*, petals, × 6.5; *e*, seed in different views, × 2.
9. *Saurauia oblancilimba* sp. nov.; *a*, leaf, × 0.5; *b*, calyx, × 1; *c*, sepal, × 6.5; *d*, petal, × 6.5; *e*, stamen, × 6.5; *f*, pistil, × 6.5.
10. *Saurauia tayabensis* sp. nov.; *a*, leaf, × 0.5; *b*, cyme, × 0.5; *c*, petal, × 3.25; *d*, calyx, × 3.25; *e*, stamen, × 6.5; *f*, pistil, × 6.5; *g*, fruit, × 1; *h*, seeds, × 6.5.
11. *Saurauia trichophora* sp. nov.; *a*, leaf, upper surface, × 0.5; *b*, cyme, × 1; *c*, corolla showing two of the petals, × 3.25; *d*, calyx showing hairs on one sepal, × 6.5; *e*, stamen, × 6.5; *f*, pistil, × 6.5.
12. *Eugenia casiguranensis* sp. nov.; *a*, leaf, × 0.5; *b*, infructescence, × 0.5.
13. *Eugenia isabelensis* sp. nov.; *a*, leaf, × 0.5; *b*, infructescence, × 0.5.
14. *Maesa davaensis* sp. nov.; *a*, portion of branch showing leaf and young fruits, × 1; *b*, flower, × 13; *c*, ovary and corolla with stamens not shown, × 13; *d*, bracteole, × 13; *e*, sepal, × 13; *f*, portion of corolla, × 13.
15. *Clerodendron apayaoense* sp. nov.; *a*, leaf, × 0.5; *b*, flower, × 1.
16. *Cyrtandra aeruginosa* sp. nov.; *a*, habit, × 0.5; *b*, calyx and portion of corolla, × 6.5; *c*, corolla, × 3.25; *d*, pistil, × 6.5.
17. *Cyrtandra disparifolia* sp. nov.; *a*, habit, × 0.5; *b*, calyx and portion of corolla, × 6.5; *c*, corolla, × 6.5; *d*, pistil, × 6.5.
18. *Cyrtandra glabrilimba* sp. nov.; *a*, habit, × 0.5; *b*, calyx, flower buds and bracts, × 6.5; *c*, corolla, × 6.5; *d*, pistil, × 6.5.
19. *Cyrtandra loheri* sp. nov.; *a*, habit, × 0.5; *b*, calyx, × 6.5; *c*, corolla, × 3.25; *d*, pistil, × 6.5.
20. *Cyrtandra mucronatisepala* sp. nov.; *a*, habit, × 0.5; *b*, calyx, × 3.25; *c*, corolla, × 2; *d*, pistil, × 3.25; *e*, fruit, × 1.
21. *Cyrtandra similis* sp. nov.; *a*, habit, × 0.5; *b*, calyx, × 6.5; *c*, corolla, × 3.25; *d*, pistil, × 6.5; *e*, fruit, × 3.25.
22. *Cyrtandra tenuisepala* sp. nov.; *a*, habit, × 0.5; *b*, calyx × 6.5; *c*, corolla, × 6.5; *d*, pistil, × 6.5; *e*, fruit, × 3.
23. *Staurogyne balabacensis* sp. nov.; *a*, habit, × 0.5; *b*, bracts, × 3.25; *c*, calyx, × 3.25; *d*, corolla, × 3.25; *e*, pistil, × 6.5; *f*, stamen, × 6.5; *g*, capsule, × 3.25.
24. *Hemigraphis cardiophylla* sp. nov.; *a*, habit, × 0.5; *b*, bracts, × 6.5; *c*, calyx and pistil, × 6.5; *d*, portion of corolla of unopened flower showing stamens, × 6.5; *e*, capsule, × 6.5.

FIG. 25. *Hedyotis mindorensis* sp. nov.; *a*, habit, × 0.5; *b*, lower leaf, × 0.5; *c*, stipule, × 6.5; *d*, bracteoles, × 6.5; *e*, calyx, × 6.5; *f*, corolla, × 20; *g*, capsule, × 6.5.

26. *Ophiorrhiza davaensis* sp. nov.; *a*, habit, × 1; *b*, flower, corolla removed, × 13; *c*, corolla, × 13; *d*, fruit, × 6.5.

27. *Psychotria balabacensis* Merr.; *a*, habit, × 0.5; *b*, lower leaf, × 0.5; *c*, flower, × 6.5; *d*, calyx, × 6.5; *e*, stamen, × 6.5.

28. *Psychotria pubilimba* sp. nov.; *a*, habit, × 0.5; *b*, flower, corolla removed, × 6.5; *c*, corolla, opened, × 6.5; *d*, fruit, × 1.

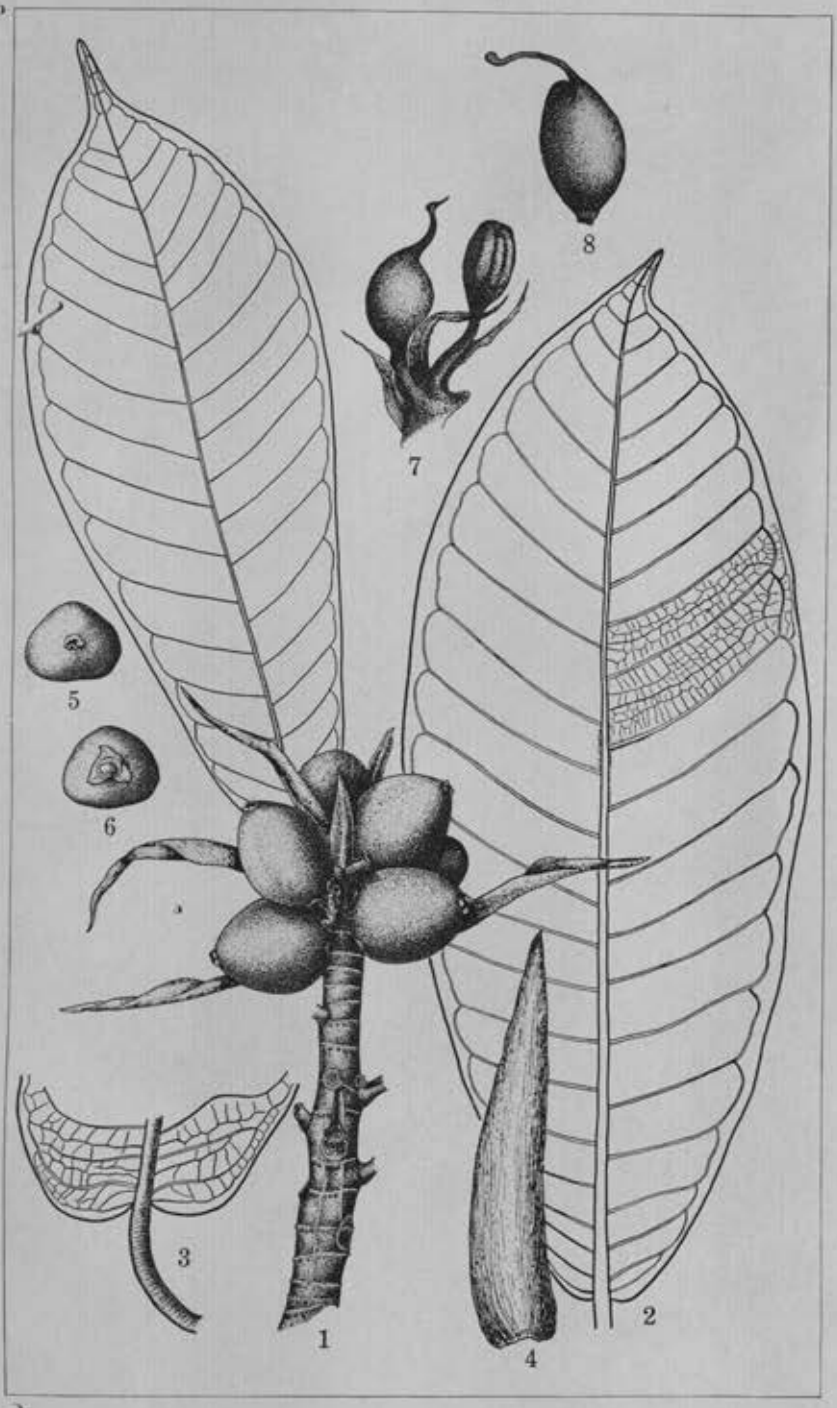


PLATE 1. FICUS BALABACENSIS SP. NOV.

PLATE 2. THOTTEA PHILIPPINENSIS SP. NOV.

PLATE 3. DERRIS FERRUGINOIDES SP. NOV.

THIOCHAULMOOGRA COMPOUNDS
THIOCHAULMOOGRAMIDE, ANILIDE, AND TOLUIDES

By IRENE DE SANTOS and AUGUSTUS P. WEST
Of the Bureau of Science, Manila

Various derivatives of chaulmoogric acid have been made from chaulmoogra oil. In the present investigation a few thiochaulmoogra compounds were prepared. The method of preparation consisted in treating the amide, anilide, and toluides of chaulmoogric acid with phosphorus pentasulphide. The results seem to indicate that these crystalline thiochaulmoogra compounds may be prepared rather easily. The new compounds prepared in this research will be tested for their therapeutic value. In order to check the formulas of these compounds, the sulphur content was determined by the method of Gebauer-Fulnegg and Petertil.[1] This method consists in fusing the sample with a mixture of sodium carbonate and peroxide. The melt is extracted with water, acidified with hydrochloric acid, and the sulphur precipitated as barium sulphate.

EXPERIMENTAL PROCEDURE

The chaulmoogra oil used in this investigation was kindly presented to us by Dr. H. I. Cole, of the Philippine Bureau of Health, and was shipped directly to us from the Culion Leper Colony. The oil was prepared from the seeds of *Hydnocarpus alcalæ* C. de Candolle. This oil contains about 90 per cent of chaulmoogric acid.[2] Since the chaulmoogric acid content of this oil is unusually high it naturally serves as a good source of material for the preparation of chaulmoogric acid and its derivatives and also chaulmoogryl substituted compounds.[3]

[1] Monatsh. 48 (1927) 619.

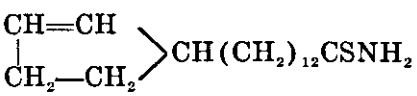
[2] Brill, H. C., Philip. Journ. Sci. § A 12 (1917) 37.

[3] Herrera-Batteke, P. P., and A. P. West, Philip. Journ. Sci. 31 (1926) 161. Santiago, S., and A. P. West, Philip. Journ. Sci. 33 (1927) 265; 35 (1928) 405. Santos, I. de, and A. P. West, Philip. Journ. Sci. 38 (1929) 293 and 445.

The chaulmoogric acid, acid chloride, and acid amide of chaulmoogric acid were prepared according to the procedure of Santiago and West.[4] Chaulmoogra oil was saponified with alcoholic potassium hydroxide. The residual soaps were decomposed with dilute sulphuric acid and the free acids extracted with ether. The ether extract was dehydrated with anhydrous sodium sulphate and filtered, after which the solution was distilled to eliminate the ether. The residue was treated with gasoline, and the precipitated resin acids were separated by filtering. The solution was evaporated somewhat and allowed to crystallize. The crude product was recrystallized several times from alcohol (95 per cent). The melting point of the purified chaulmoogric acid was 68° C.

The acid chloride of chaulmoogric acid was prepared by treating melted chaulmoogric acid with phosphorus trichloride. The reaction was finished in about fifteen minutes. The reaction product was filtered through glass wool to remove the viscous phosphorous acid, and the clear filtrate consisting of the acid chloride of chaulmoogric acid was allowed to drop slowly into cold concentrated ammonia. The precipitated amide was washed with water and dried. The amide was crystallized from methyl alcohol and also from xylene. The crude product was then dissolved in absolute alcohol, the solution decolorized with vegetable carbon (suchar), and crystallized. The melting point of the amide was 104 to 105° C.

THIOCHAULMOOGRAMIDE



This compound was prepared by treating the acid amide of chaulmoogric acid (15 grams) with powdered phosphorus pentasulphide (3 grams). These materials were mixed thoroughly in a mortar and then placed in a 1-liter round flask. Benzene (150 cubic centimeters) was added and the mixture heated (reflux) on a water bath for one day. During the process of heating the mixture was shaken frequently. The crude reaction product consisted of a dark brown liquid together with some brown gelatinous matter. The gelatinous matter was separated from the dark brown liquid by filtering. It was then extracted

[4] Philip. Journ. Sci. 33 (1927) 265.

with benzene, and the benzene extract combined with the dark brown liquid previously separated from the gelatinous matter. After evaporating somewhat, the yellow mass solidified. The yellow mass was then extracted with carbon bisulphide to eliminate the sulphur contained in it. The extracted product was then dissolved in methyl alcohol, the solution decolorized with vegetable carbon (suchar), and filtered. The filtrate which contained a small quantity of finely divided carbon was treated with talcum powder, shaken, and again filtered to remove the carbon. The solution was evaporated and allowed to crystallize. The crystals of thiochaulmoogramide were separated from the unchanged chaulmoogramide by treating with petroleum ether which dissolved the thioamide. The yield of thiochaulmoogramide was about 20 per cent, and the melting point of the white crystals was 75 to 76° C. The thioamide had a disagreeable odor resembling decomposed eggs and was found to be soluble in the following solvents: Ethyl alcohol, methyl alcohol, acetone, benzene, carbon tetrachloride, ethyl acetate, ether, and petroleum ether. It is also slightly soluble in carbon bisulphide.

Analysis:

	Sulphur. Per cent.
Calculated for $C_{18}H_{33}NS$	10.86
Found	10.76

ANILIDE AND TOLUIDES OF CHAULMOOGRIC ACID

The thiochaulmoogranilide and toluide compounds recorded in this paper were prepared in a manner similar to that employed in making the thiochaulmoogramide. The anilide and toluides of chaulmoogric acid were converted into the thio compounds by treating them with phosphorus pentasulphide.

The anilides and toluides of chaulmoogric acid may be prepared by Kelbe's reaction [5] which consists in treating the amide of chaulmoogric acid with aniline and the toluidines. According to our experience, however, larger yields of the purified anilide and toluides may be obtained by means of Goldberg's reaction.[6] This consists in treating the amide of chaulmoogric acid with brom benzene and the brom toluenes in the presence of metallic copper.

[5] Ber. Deut. Chem. Gesell. 16 (1883) 1199.
[6] Ber. Deut. Chem. Gesell. 39 (1906) 1691.

Chaulmoogranilide.—This compound was prepared by treating the acid amide of chaulmoogric acid (20 grams) with brom benzene (8 cubic centimeters) in the presence of powdered metallic copper (0.2 gram) and sodium acetate (5 grams). The powdered metallic copper was prepared by reducing powdered black copper oxide in a current of hydrogen. The mixture was heated (reflux) in a Crisco oil bath at 110° C. until no more acid vapors were evolved. This required about three days. The reaction product was dissolved in methyl alcohol and the catalyst removed by filtering. The filtrate was decolorized with vegetable carbon (suchar) and filtered. The solution was treated with talcum powder and again filtered to remove traces of finely divided suchar. When the solution was evaporated somewhat, slightly yellowish crystals of chaulmoogranilide were obtained. The melting point was 88° C.

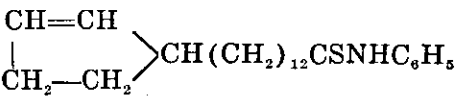
Toluides of chaulmoogric acid.—These compounds were prepared in a manner similar to that employed in making the anilide of chaulmoogric acid.

The ortho toluide of chaulmoogric acid was made by heating for three days (110° C.) a mixture consisting of chaulmoogramide (30 grams), *o*-brom toluene (13.5 cubic centimeters), sodium acetate (5 grams), and powdered metallic copper (0.2 gram). When the reaction product was purified, crystals which melted at 93 to 95° C. were obtained.

By heating a mixture consisting of chalmoogramide (15 grams), *m*-brom toluene (6.5 cubic centimeters), sodium acetate (5 grams), and powdered metallic copper (0.2 gram) for three days (115° C.) the meta toluide of chaulmoogric acid was obtained. The melting point was 88° C.

The para toluide of chaulmoogric acid was prepared by heating a mixture consisting of chaulmoogramide (30 grams), *p*-brom toluene (13.6 cubic centimeters), sodium acetate (5 grams), and powdered metallic copper (0.2 grams). The mixture was heated for two days at a temperature of 140° C. The melting point was 98 to 100° C.

THIOCHAULMOOGRANILIDE



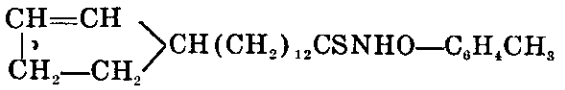
This compound was prepared by treating the anilide of chaulmoogric acid (10 grams) with powdered phosphorus pentasulphide (1.6 grams). The materials were heated in a round flask

on a water bath until they were completely melted. This required about an hour. Benzene (100 cubic centimeters) was now added to the hot sirupy mass. When heated for another hour on a water bath most of the reaction product dissolved leaving only a small amount of a gray powdery residue. The mixture was now filtered, and, after evaporating somewhat, the filtrate crystallized. The crystals were extracted with carbon bisulphide to eliminate the sulphur. After drying on filter paper to remove traces of carbon bisulphide the crystals were dissolved in methyl alcohol and the solution decolorized with suchar. The solution was then treated with talcum powder, filtered, and allowed to crystallize. As the crystals of thiochaulmoogranilide contained unchanged chaulmoogranilide they were treated with cold petroleum ether which dissolved the thio compound. The yield of thiochaulmoogranilide was about 15 per cent, and the melting point of the slightly yellowish crystals was 55 to 57° C. The thio compound had a rather unpleasant odor and was found to be soluble in the common organic solvents; such as, methyl and ethyl alcohols, acetone, benzene, carbon tetrachloride, ether, and petroleum ether.

Analysis:

	Sulphur. Per cent.
Calculated for $C_{31}H_{47}NS$	8.64
Found	8.52

THIOCHAULMOOGRA O-TOLUIDE



By heating for about a half hour a mixture consisting of chaulmoogra *o*-toluide (10 grams) and phosphorus pentasulphide (1.6 grams), the thiochaulmoogra *o*-toluide was obtained. Benzene (100 cubic centimeters) was then added and the mixture heated (reflux) on a water bath for an hour longer to complete the reaction. The reaction product was extracted with carbon bisulphide and crystallized from methyl alcohol containing suchar. The thio compound was extracted from the impure product by means of cold petroleum ether. The crystals obtained were slightly yellow and gave a melting point of 98 to 100° C. The thio compound had a rather disagreeable odor and was found to be soluble in the following solvents: Acetone, benzene, ethyl alcohol, ethyl acetate, ether, ethyl benzoate,

toluene, methyl alcohol, and isobutyl alcohol. The yield was about 10 per cent.

Analysis:

	Sulphur. Per cent.
Calculated for $C_{25}H_{39}NS$	8.33
Found	8.29

THIOCHAULMOOGRA M-TOLUIDE

$$\begin{matrix} CH{=}CH \\ | \\ CH_2{-}CH_2 \end{matrix}\!\!>\!CH(CH_2)CSNH{-}M{-}C_6H_4CH_3$$

In the preparation of this substance the procedure used was similar to that employed in making thiochaulmoogra *o*-toluide. The interaction of chaulmoogra *m*-toluide and phosphorus pentasulphide gave the thiochaulmoogra *m*-toluide. When crystallized from cold petroleum ether white crystals, which melted at 78 to 79° C., were obtained. The yield was about 20 per cent. Thiochaulmoogra *m*-toluide has an unpleasant odor and is soluble in the following solvents: Ethyl and methyl alcohols, isobutyl alcohol, benzene, carbon tetrachloride, acetone, ethyl acetate, and petroleum ether.

Analysis:

	Sulphur. Per cent.
Calculated for $C_{25}H_{39}NS$	8.33
Found	8.30

THIOCHAULMOOGRA P-TOLUIDE

$$\begin{matrix} CH{=}CH \\ | \\ CH_2{-}CH_2 \end{matrix}\!\!>\!CH(CH_2)_{12}CSNHP{-}C_6H_4CH_3$$

When chaulmoogra *p*-toluide is treated with phosphorus pentasulphide the thiochaulmoogra *p*-toluide is obtained. The experimental procedure was practically the same as that employed in making the previous thiochaulmoogratoluides. White crystals which melted at 80° C. were obtained by crystallizing a cold petroleum ether solution of this substance. The yield was about 15 per cent. Thiochaulmoogra *p*-toluide, like the other thiochaulmoogra compounds, has an unpleasant odor. It was found to be soluble in the following solvents: Acetone, benzene, absolute alcohol, ethyl acetate, ether, ethyl benzoate, toluene, carbon tetrachloride, methyl alcohol, and isobutyl alcohol.

Analysis:

	Sulphur. Per cent.
Calculated for $C_{28}H_{29}NS$	8.33
Found	8.16

SUMMARY

Five thiochaulmoogra compounds were prepared in this investigation; namely, thiochaulmoogramide, thiochaulmoogranilide, thiochaulmoogra *o*-toluide, thiochaulmoogra *m*-toluide, and thiochaulmoogra *p*-toluide.

These thiochaulmoogra compounds were prepared by treating the amide, anilide, and toluides of chaulmoogric acid with phosphorus pentasulphide. Our results indicate that these thio compounds may be prepared rather easily. They are crystalline substances and have a rather disagreeable odor.

The anilides and toluides of chaulmoogric acid, which were used in making the thio compounds, may be prepared by Kelbe's reaction. This consists in treating the amide of chaulmoogric acid with the proper aromatic amine. According to our experience more satisfactory yields are obtained by Goldberg's reaction which consists in treating the amide of chaulmoogric acid with the proper aromatic halogen compound in the presence of metallic copper.

ACKNOWLEDGMENT

We wish to express our thanks and appreciation to Dr. Otto Schöbl, of the Bureau of Science, Manila, for determining the bactericidal properties of these thio compounds.

TRANSMISSION OF THE VIRUS OF DENGUE FEVER FROM MOSQUITO TO MOSQUITO [1]

By JOE H. ST. JOHN
Major, Medical Corps
JAMES STEVENS SIMMONS
Major, Medical Corps
and
FRANCOIS H. K. REYNOLDS
Captain, Veterinary Corps

ONE PLATE AND TWO TEXT FIGURES

The experiments outlined in this report prove that it is possible to pass the virus of dengue fever directly from infected to normal *Aëdes ægypti* mosquitoes. The passage has been accomplished by feeding normal *A. ægypti* on blood containing a suspension of macerated mosquitoes known to be able to transmit dengue.

EXPERIMENTAL PROCEDURE

Technic.—The fresh, clean skin of a normal, young exsanguinated guinea pig was freed of hair and clamped tightly over the shallow depression on the under surface of the lid of an ordinary rectangular staining dish (Plate 1, fig. 1) by means of a wire frame held in place by rubber bands. The air was removed from the cell with a Leur syringe and replaced by a mixture of normal citrated human blood [2] and macerated dengue-infected *Aëdes ægypti.* Sufficient of this material was injected to cause a distinct bulging of the skin, after which the needle hole was sealed

[1] From the United States Army Medical Department Research Board, Bureau of Science, Manila, Philippine Islands.

[2] The blood used was obtained from volunteers who were in the observation period preliminary to dengue experimentation. The blood was proved to be free of virus at the time it was taken, by subsequent observation of the volunteer for dengue for eight days, and by producing dengue fever in these individuals a few days after the end of the observation period, by known infected mosquitoes.

with melted paraffin. The mixture was kept at approximately 37° C. by placing the inverted glass lid over the staining dish which had been half filled with water heated to 55° C. The entire apparatus was then inserted into a cage containing normal laboratory-bred *A. ægypti.* The mosquitoes were at once attracted to the skin, and in a short time most of them became engorged with the blood mixture (Plate 1, fig. 2). This technic of infecting *A. ægypti* was carried out on four different occasions, and the various lots of mosquitoes obtained were combined and used to infect two American soldiers. The protocols of these two experimental cases are given below:

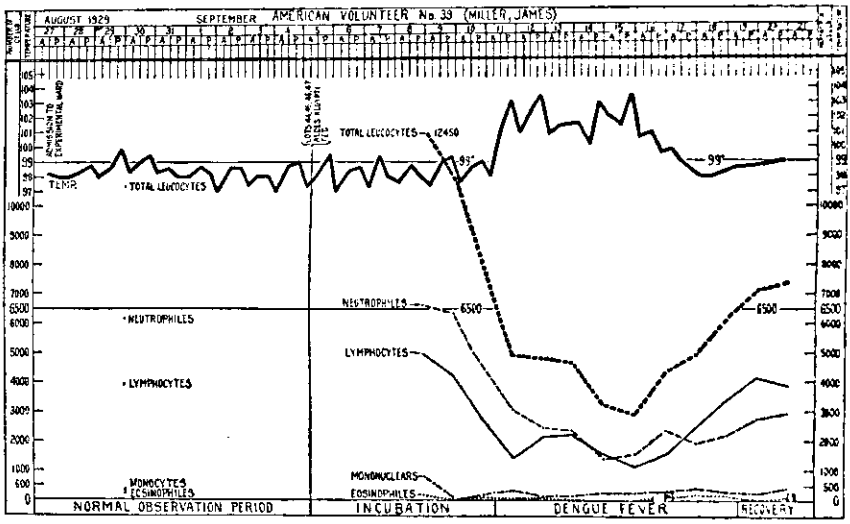


FIG. 1. Chart of American volunteer 39.

PROTOCOLS

Experiment 1.—American volunteer No. 39 (Miller, Serial No. 6811238), Pvt. Hd. Co., 31st Infantry; age 18 years; born in Pennsylvania, and lived in Harrisburg, Pa. Arrived in Philippine Islands June 15, 1929. No history of dengue. Admitted to experimental ward, Sternberg General Hospital, U. S. Army, Aug. 27, 1929 (No. 101766). Physical examination and routine laboratory tests showed him to be normal. *Preliminary observation period,* eight days, from Aug. 27, to Sept. 5, 1929. No evidence of dengue.[3] *Experiment.* On Sept. 5, 1929, seven *A. ægypti* of lot 44, three of lot, 45, three of lot 46, and thirty-four of lot, 47, took full

[3] Each volunteer admitted for experimental dengue is confined to a screened cubicle within a screened ward.

blood feedings from the patient. The mosquitoes of these lot numbers had been fed 16, 16, 14, and 12 days previously by the method outlined under "Technic," on citrated normal human blood which contained a suspension of infected *A. ægypti* in the ratios of 16, 6.25, 13.33, and 12 mosquitoes, respectively, per cubic centimeter of blood. *Dengue fever.* Onset six days later, the morning of Sept. 11, 1929. Symptoms typical, including fever, leucopenia (see fig. 1), headache, pain in eyeballs, nausea, dizziness, perversion of taste, and a primary rash which appeared on Sept. 11, 1929. There was no terminal rash. The temperature returned to normal on Sept. 17, and the leucopenia lasted until Sept. 19. *Conclusion.* The feeding of forty-seven normal *A. ægypti* infected from dengue mosquitoes was followed in six days by typical dengue fever.

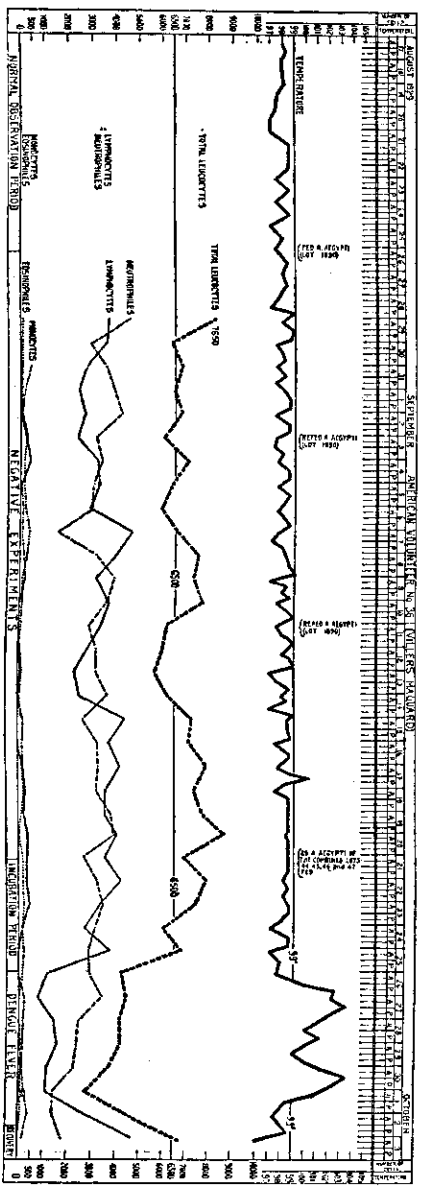


Fig. 2. Chart of American volunteer 36.

Experiment 2.—American volunteer No. 36 (Villers, Serial No. 6541434), Pvt. 66th Service Squadron, A. C.; age 23 years; service 6 months. Born in Kansas, and lived in Kansas, Idaho, and Oregon. Arrived in the Philippine Islands June 15, 1929. No history of dengue. Admitted to experimental ward, Sternberg General Hospital, U. S. Army, Aug. 17, 1929 (No. 101663). Physical examination and routine laboratory tests were negative. *Preliminary observation period,* eight days, from Aug. 17, to Aug. 26, 1929, during which there was no evidence of dengue. *Negative experiment.* On Aug. 26, 1929, he was used to test mosquitoes of our lot 1890, for infectivity. Dengue did not develop in a period of ten days following the feeding of these mosquitoes. *Positive experiment.* On Sept. 21, 1929, twenty-eight *A. ægypti* of the combined lots 44, 45, 46, and 47 took blood from this patient. *Dengue fever.* Onset six

days later, Sept. 27, 1929. The duration of the infection was five days, and the following symptoms were noted: Fever and leucopenia (see fig. 2), headache, pain on movement of eyeballs, aching joints, nausea, dizziness, generalized glandular enlargement, and a terminal rash which began Sept. 30, and lasted until Oct. 3, 1929. *Conclusion.* The feeding of twenty-eight *A. ægypti* of the combined lots 44, 45, 46, and 47, which had been fed on normal citrated blood containing dengue infected *A. ægypti* 28 to 32 days previously, was followed by typical dengue fever.

In order to prove that the technic used in the foregoing experiments had no appreciably injurious effect on the virus, normal *A. ægypti* were fed similarly through a membrane on citrated blood from cases of dengue fever. Two groups of mosquitoes (lots 49 and 53) fed in this manner, later caused typical dengue fever in two human volunteers.

DISCUSSION

The fact that dengue virus can be transferred from infected to normal *A. ægypti* without passage through a vertebrate host seems significant and may lead to a more complete knowledge of the life history of the virus. The method employed for infecting mosquitoes in the laboratory promises to be of distinct value in the study of virus diseases transmitted by mosquitoes, for a number of reasons including the following: Large numbers of infected insects may be obtained by this method without annoyance or injury to the individual; the presence of the dengue virus in cultures or contaminated material may be detected; and dengue virus may possibly be maintained in the laboratory for long periods of time by passage through mosquitoes alone.

CONCLUSIONS

1. Normal *Aëdes ægypti* have been infected with dengue virus by feeding through an animal skin on suspensions of dengue-infected *A. ægypti* in blood.

2. These mosquitoes infected from other mosquitoes produced dengue fever in two American soldiers.

3. It is believed that the method described will prove to be a valuable aid in the study of dengue fever, and possibly also to the investigation of other virus diseases transmitted by insects.

ILLUSTRATIONS

PLATE 1

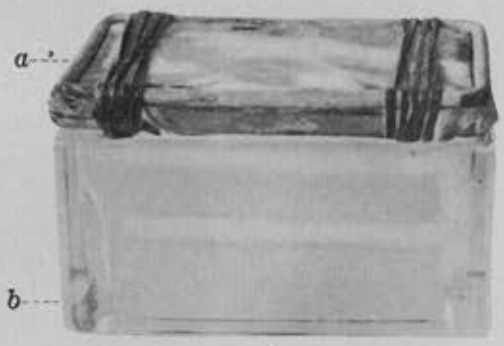
FIG. 1. Apparatus for feeding mosquitoes through skin; *a*, lid of staining dish with guinea-pig skin clamped over shallow depression which is filled with mixture of normal blood and macerated infected mosquitoes; *b*, staining dish partially filled with water heated to 55° C.

2. *Aëdes ægypti* feeding through guinea-pig skin on a mixture of normal blood and macerated dengue-infected mosquitoes.

TEXT FIGURES

FIG. 1. Chart of American volunteer 39.

2. Chart of American volunteer 36.



1

2

PLATE 1.